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REPORT

ON THE

OPERATIONS OF THE DEPARTMENT

OF

AGRICULTURE,

PUNJAB,

For the year ending the 30th June, 1908.

Published by Authority.

Price :—Annas 3 or 3d.

Lahore:
PRINTED AT THE "CIVIL AND MILITARY GAZETTE" PRESS,
Sole Contractors for Printing to the Punjab Government.

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OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, PUNJAB, FOR 1907-1908.

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Proceedings of His Honour the Lieutenant-Governor of the Punjab in Department of Revenue and Agriculture (Agriculture), No. 197, dated 21st November 1908.

READ—

Letter No. 518 S., dated the 8th October 1908, from the Senior Secretary to the Financial Commissioner, Punjab, forwarding with the comments of the Financial Commissioner, the annual report of the Department of Agriculture in the Punjab for the year 1907-08.

REMARKS.—The agricultural department in the Punjab is still in its infancy. The sanctioned staff of European experts is complete, but a considerable period must elapse before all the assistants can be recruited. The policy of choosing the staff as far as possible from the ranks of Punjab agriculturists is obviously correct, but it must entail considerable delay in selection as the field is very limited and it would be premature to express a definite opinion on the adequacy of the terms offered.

2. The hope expressed in paragraph 1 of last year's review that the college at Lyallpur would be opened by 1st July 1908 has not been realised. The internal fittings of the building, the water-supply, lighting arrangements, &c., are still incomplete, but the work should have sufficiently advanced by 1st July 1909 to enable a start to be made, and the Lieutenant-Governor has ordered the opening of the college from that date.

3. Meanwhile the members of the staff have been usefully employed in acquiring a knowledge of the agricultural conditions of the province, in becoming acquainted with the people and generally in laying the foundations of their work. In addition to this, results of some importance have been achieved in certain directions.

4. The utility and economy of mechanical reapers have been demonstrated to the colonists on the Chenab canal and 21 machines have been successfully used by private purchasers in the Lyallpur district. In the Jhelum colony the results were not so encouraging. The Deputy Director of Agriculture, who deserves credit for his zeal and energy in the matter, has recently been in England selecting a reaper that shall be better suited to the needs of the province than any of the existing types, and when this has been obtained there can be no doubt of the popularity of the machines. Demonstrations at local fairs have produced a demand for a patent hoe also, and it has become apparent that the establishment of a machinery depôt under the management of the department is a necessity until private enterprise is prepared to make adequate arrangements for supplying the growing demand. The Lieutenant-Governor is satisfied that in popularising agricultural machinery an important step has been taken to obviate what is perhaps the most serious obstacle to the development of the colonies, the scarcity of labour.

5. The results of experiments at the Lyallpur agricultural station during the year have been mostly of a negative kind. So far as they go they have been, on the whole, in favour of the indigenous varieties of cereals and cottons. The Imperial Economic Botanist has completed his classification of the types of Punjab wheat and has thus laid a sound basis for experiments to determine the species best suited to various conditions of soil and climate. The Lieutenant-Governor desires to thank him for this most useful piece of work.

6. Other important experiments have been made in connection with the appearance of reh, and some tentative conclusions on the subject have been arrived at, but progress is stopped for the time being by the want of a chemical laboratory. This investigation is of the first importance to the whole province and especially to the Chenab colony and other canal tracts. His Honour awaits further developments with the greatest interest and trusts that a practical solution of the problem may be discovered.

7. The report on the demonstration of Mr. Hadi's sugar-making process has been read by the Lieutenant Governor and orders passed on it. It was somewhat unfortunate that a demonstration was undertaken before the suitability of the plant to the conditions of the Punjab had been definitely ascertained.

The past season was exceptionally unfavourable to sugar-making, and this was partly the explanation of the failure. Further experiments will be made in a tract more suitable for the working of the plant.

8. The other work of the past year, experiments with jute, cotton and manures, the operations of the Sargodha seed-farm and the identification of the ear-cockle pest in wheat, have been sufficiently noticed in the remarks of the Financial Commissioner. Sir Louis Dane will follow with special interest the attempt to revive sericulture in the Punjab. He fully concurs in the views of the Financial Commissioner as to the attitude that should be adopted towards agricultural associations. Their formation is one of the most hopeful signs of the times, indicating as it does, an awakening of the agricultural population and a desire to investigate in a practical manner the problems that affect them most nearly. His Honour is glad to note that the Lyallpur and Hissar associations have already shown considerable capacity for doing useful work.

9. As regards paragraph 10 of the Financial Commissioner's review the figures given by the Director of Agriculture appear to be of doubtful accuracy. This will be investigated separately. Whatever balance there may be still unexpended out of the imperial and provincial grants of 4 lakhs yearly will easily be utilized in the next few years in the construction and equipment of the buildings still required.

10. The Lieutenant-Governor desires to thank Mr. Renouf for his zealous administration of his department and his scientific colleagues for their good work under conditions which were not altogether favourable.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Senior Secretary to the Financial Commissioner, Punjab, for information, that they be published in the *Punjab Gazette* and submitted to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor,

W. S. HAMILTON,

Offg. Secretary to Government, Punjab.

Punjab Government Press, Lahore—23-11-08—5217—464—C. L.

No. 518 S.

FROM

E. R. ABBOTT, ESQUIRE,
Senior Secretary to the Financial Commissioner, Punjab,

TO

W. S. HAMILTON, ESQUIRE,
Secretary to Government, Punjab.

Dated Simla, 8th October 1908.

SIR,

I AM directed to forward a letter No. 2621, dated 15th September 1908, from the Director of Agriculture, covering his annual report on his Department for the year 1907-08, with a separate note containing the comments of the Financial Commissioner.

I have, &c.,

E. R. ABBOTT,
Senior Secretary to the Financial Commissioner, Punjab.

Punjab Government Branch Press, Simla,—12-10-08—343—400

Comments by the Hon'ble Mr. J. Wilson, C. S. I., Financial Commissioner, Punjab, on the annual report of the Department of Agriculture, Punjab, 1907-08, dated 6th October 1908.

1. With the arrival of the Economic Botanist the superior expert staff of the Department has been completed. Sanction has been obtained to the cadre of the subordinate staff of the general branch and of the College. The progress which has been made in filling up these appointments is explained in paragraphs 10 to 12 of the report. That suitable men would not be at once available was only to be expected, and the policy adopted by the Director of selecting candidates with great care and of not attempting to force the pace is undoubtedly the right one.

It seems doubtful whether the pay and prospects at present offered are sufficient to attract men with the necessary scientific qualifications.

2. The Director hopes to be able to open the Agricultural College in July next, and it appears that as far as the buildings are concerned there will be nothing to prevent a start being made then, though the work may be to some extent hampered if the laboratories are not completely equipped in time. In any case I think it will then be time to make a beginning, and the Director and his staff should be definitely instructed to make arrangements for opening the College with a small number of selected students in July 1909 whether the laboratories are ready or not. The College buildings are handsome, commodious and well designed. As regards the question of the curriculum, a reply has been forwarded to the Local Government on the points raised by the Government of India and on the further detailed proposals made by the Director.

3. Important work is being carried out at the Lyallpur Agricultural station in the classification of indigenous and imported wheats and cottons. We are indebted to Mr. Howard for his careful classification of the Punjab wheats, which will be a very useful basis for future operations. The experiments on jute are interesting, but it is far from being demonstrated as yet that it can be grown in the Punjab as a commercially paying crop. The seed-farm at Sargodha has had a bad year in common with the Jhelum Colony generally, but conditions so abnormal are not likely to recur ; and it is evident that the farm is on a sound basis and that it serves a useful purpose. The arrangements for establishing a second Agricultural station in the Jullundur district should be pushed on, and it will probably be found desirable to have a third in the South-West Punjab, where the conditions are quite dissimilar from those of the rest of the Province.

4. The comparative failure of introduced varieties of American cottons in the Chenab and Jhelum Colonies and of Egyptian cottons in the South-West Punjab, though primarily due to the abnormal season, shows that we have not yet obtained types which can stand the effects of the Indian climate and that these foreign cottons should not be pushed until a type more suitable to the country has been produced. The attempt to improve indigenous cottons shews better promise, though here too the superior strains will have to be evolved at the agricultural stations. The assistance given to the department in this case by Mr. Townsend in Hissar has been valuable, but few District or Settlement Officers have the time and experience to be able to take up special work of this kind, and the department will have to rely chiefly on itself until local agricultural associations are sufficiently developed to be able to give useful assistance.

5. Much useful work has been done during the year in collecting and arranging information concerning the Punjab insect pests. The identification of the wheat ear cockle is interesting.

6. Considerable progress has been made in the efforts to popularize agricultural machinery to take the place of manual labour, which has now become so expensive owing to the general rise of wages. Mr. Milligan's interest in the subject has led to very encouraging results especially in providing a reaping machine suited to the requirements of the Punjab farmer. The sanction of

Government has now been obtained to the establishment of a machinery depôt at Layallpur to stock agricultural machines for sale to private persons. It is intended that this depôt should be closed as soon as a private agency can be found to undertake the work, and there is some hope that this will shortly be arranged. The demonstrations of the sugar-making plant, used with success in the United Provinces by Mr. Hadi, seem to show that the process is not likely to prove profitable in the North Punjab, but it might perhaps be tried with advantage in the Delhi division. Mr. Milligan's detailed report is now under consideration, and the orders of Government will shortly be taken as to whether the experiment should be continued.

7. A preliminary report on the investigations into the saline efflorescence known as *reh* has been submitted to Government, but further investigations have had to be postponed until the chemical laboratory is ready. It will be seen from the Director's report, as well as from those of the Deputy Director and of the Agricultural Chemist, that the importance of the subject is thoroughly appreciated, and particularly that aspect of it which consists of the appearance of *reh* in soils previously considered free from the taint.

8. The attention of the Department has been usefully directed to the popularization of castor cake as a manure and to the promotion of sericulture. The programme of proposed new lines of work given in paragraph 54 of the Director's report shews that there is no lack of objects upon which its energies can be employed.

9. The attitude adopted towards agricultural associations by the Director seems hardly sufficiently sympathetic. It is true that the Department is not yet in a position to assist these local associations to any great extent with practical suggestions and authoritative information. But, on the other hand, the example of the Lyallpur and Hissar associations seems to prove that such bodies can even under present conditions do useful work and develope local problems for the consideration of the Department which can learn from them as well as teach them ; and it is important that the experts should keep in close touch with practical farmers and others interested in agriculture. I think therefore that wherever a Deputy Commissioner or the Director finds a desire expressed that an Agricultural Association should be established or a show organised, he should endeavour to meet the wish of the people.

10. Appendix IV, which was called for at the suggestion of Government, shows how far it has been found possible to utilise the additional grant of 4 lakhs per annum contributed to the Department by the Imperial and Provincial Governments. The Director makes out that of the 12 lakhs thus practically promised for agricultural and veterinary development for the last three years only 7 lakhs have been expended, so that 5 lakhs are still available from past allotments for further initial expenditure. It would also seem that we are at liberty to contemplate an ultimate recurring expenditure, including that on buildings, of Rs. 5,17,314 per annum on the two departments. The figures will no doubt be checked by Government, but if they are approximately correct, I hope that funds will be readily found as required for the proper equipment of both departments, and especially for the completion of the buildings and staff of the Agricultural College.

11. The Agricultural Department is still in its initial stage, and the experts are still chiefly engaged in learning the conditions of the Province and in organizing their future work. Their operations have been hampered by an unusually bad year, but the experience should at least be useful in bringing home to them the difficulties under which the Punjab farmer labours at times, even where he enjoys the benefit of canal irrigation for his fields. They seem to have started on right lines, and there is ground for hope that their studies and experiments will in time lead to a substantial advance in Punjab agriculture. They should not be too hasty in arriving at conclusions or in suggesting apparent improvements, and should always bear in mind that their work is expected to lead to practical results such as will benefit the small peasant farmer. Mr. Renouf has administered the department with success and his advice has been most useful.

Punjab Government Branch Press, Simla,—12-10-08—343—400.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING JUNE 30TH, 1908.

Part I.—Administrative.

Personal.

1. Mr. French held charge of the department until my return from furlough on November 6th, 1907.

Tours.

2. Mr. French spent 39 days on tour and visited the districts of Lahore, Lyallpur, Karnal and Delhi. I was 127 days on tour in the districts of Delhi, Ambala, Jullundur, Amritsar, Kangra, Lahore, Lyallpur, Ferozepore, Shahpur, Gujranwala and Rawalpindi. I attended cattle fairs at Amritsar, Ambala, Muktsar and Lyallpur, and exhibitions of agricultural produce at the three last named places. I also attended the Veterinary Conference at Calcutta, and the meeting of the Board of Agriculture at Pusa in February.

The two Provincial Circles.

3. The formation of the two Provincial Circles is in abeyance pending the acquisition of a site for an agricultural station in the Jullundur District. The Professor of Agriculture at the Agricultural College has been asked to report on the problems for investigation in the South-West Punjab, and, if an agricultural station is needed, to suggest where it should be located. Everything will thus be in readiness for starting this agricultural station when a competent manager has been trained.

European staff.

4. The European staff was completed with the appointment of Mr. Milne, B. Sc., as Economic Botanist, on November 9th, 1907.

The Deputy Director.

5. Mr. Milligan's head-quarters continue at Lyallpur for the present. His annual report is printed as Appendix II. It shows the work on which he was occupied and indicates the extent of his tours. He conducted the operations with reapers with great care and thoroughness, and the success of the reapers is largely due to the personal assistance which he gave to purchasers at harvest time. He also took great trouble in the selection of a site for the Eastern Punjab Agricultural Station, and I hope that it will be possible to acquire the land speedily and to thus provide him with a centre for experimental work in the Eastern Punjab. A second farm is one of the most urgent needs for the extension of the work of the department.

The Principal, Punjab Agricultural College.

6. Mr. Dobbs was in charge of the office of Principal of the Lyallpur Agricultural College and of the Lyallpur Agricultural Station. The duties attached to the post of Principal have been light up to the present, and most of Mr. Dobbs' attention was given to the Lyallpur Farm. In a six weeks tour during the rains in 1907, he visited agricultural stations at Cawnpore, Poona, Surat, Nagpur, Pusa and Jullundur. January was spent on tour in the Jhelum Colony, Gujrat, Sialkot and Amritsar. Sialkot and Rawalpindi were also visited in May. Mr. Dobbs is being transferred to Bengal, and Mr. Corbin from Bengal will succeed him as Professor of Agriculture, Mr. Barnes assuming charge of the office of Principal. The report on the Lyallpur Agricultural Station is attached to this report as Appendix I.

The Agricultural Chemist.

7. The work of the Agricultural Chemist, Mr. Barnes, has been greatly hampered for the want of a laboratory, and by reason of the delay in the receipt of sanction to his staff. I, however, agree with Mr. Barnes that this has allowed him time for important local investigations, and that he has been able to acquire a knowledge of the Province which will be of great value to him later on. Now that his staff has been sanctioned

I have arranged through the kindness of the Pusa authorities, for laboratory accommodation for him at Pusa, and he will work there until his own laboratory is ready. I am indebted to Mr. Barnes for much well-considered advice and assistance in connection with the College. Appendix III contains a brief note on Mr. Barnes' work.

The Economic Botanist.

8. Mr. Milne, B. Sc., Economic Botanist, joined the department on November 9th, 1907, and he has been extremely busy from the start. In the absence of Professors of Mycology and Entomology, Mr. Milne will also be in charge of these two sections. His duties as Economic Botanist relate to the introduction and improvement of agricultural crops, and this section having been taken up by Mr. Dobbs before Mr. Milne's arrival, Mr. Milne worked with him during the winter. A formal transfer of charge was effected in the spring. Mr. Milne has toured very extensively in the Province and also visited Pusa, Calcutta, Cawnpore and Poona in connection with the question of laboratory fittings and the curriculum. The preparation of specifications of fittings, of indents for apparatus, and the selection of men for the posts of Assistant Professor and Laboratory Assistant, have occupied a great deal of time. Mr. Milne has been given two Agricultural Assistants to work under his directions on wheat and cotton, and he will need another for other crops and for the collection of plants for the Herbarium. Mr. Milne has shown great activity and thoroughness in organising his work and in training his staff. Mr. Milne's work has been largely of a preliminary character, and has been summarised in the main report.

The North-West Frontier Province.

9. No agricultural expert has yet been appointed to the North-West Frontier Province; consequently, the operations of the department are still confined to the Punjab.

Subordinate staff, the general branch.

10. Three Assistant Directors and a cadre of 30 Agricultural Assistants were sanctioned by the Government of India in January. Two of the Assistant Directors are to be on salaries of Rs. 150—10—300, and one on a salary of Rs. 300—10—400. These posts will be filled as the work developes. Sundar Singh, B.A., has been appointed to one of the Assistant Directorships on three years' probation and he is being sent to Pusa for two years' training. The staff of Agricultural Assistants has been reduced from 9 to 7 by the resignation of one man, and the return of another to his original appointment on the completion of his probationary period. The present establishment is too small for our present requirements, but there will be a useful addition next March when 5 stipendiaries will pass out from the Cawnpore Agricultural College. There are now 8 stipendiaries at the Cawnpore Agricultural College and 4 more are to be sent this autumn. The Agricultural Assistants who joined last year have been under training in various branches. They naturally need a great deal of practical instruction, but they have done satisfactorily and have rendered useful assistance in many directions.

Subordinate staff for the College.

11. Assistant Professors in Agriculture, Agricultural Chemistry, Economic Botany, Mycology and Entomology on Rs. 150—10—300, and six Laboratory Assistants, three on Rs. 50—4—90, and three on Rs. 100—5—150, were also sanctioned by the Government of India in January. Two Laboratory Assistants are for Agricultural Chemistry, and one is to be provided for each of the other sections. It is of course impossible to obtain men with a knowledge of agricultural science, and it has accordingly been decided to look out for the most promising men with a good general and scientific education, deputing them afterwards to Pusa for one or two years' special training. The Agricultural Chemist will find it convenient to train his own men and is indeed compelled to do so by force of circumstances as, unless he does this, he is left absolutely without assistants for two years. He anticipates that his men will render useful help during their period of training. A bond has been taken from each man sent to Pusa binding him to serve the Provincial Government for at least five years if so required, and stipulating for the refund of sums paid to him while at Pusa in certain contingencies. The appointment of Punjab Agriculturists is being kept in view, and a close connection with the soil is regarded as essential for the purely agricultural posts.

Difficulties in the recruitment of Assistant Professors and Laboratory Assistants.

12. It is a very essential part of our scheme that the Assistant Professors and Laboratory Assistants should discharge responsible duties. The Assistant Professors should relieve the Professors of most of the teaching, leaving them sufficient time for research and other work. The Laboratory Assistants should be capable of working independently and without constant supervision. It is therefore desirable that we should secure really good men. In most cases, however, the applications received have been very disappointing. Advertisements were inserted in the leading newspapers, notices were posted up in the principal colleges, and personal enquiries were also instituted, but it was soon apparent that the prospects were not regarded as particularly attractive and compared unfavourably with those offered by other Departments. Only three appointments out of eleven have been made in four months, these being those of Mr. Carson as Assistant Professor of Entomology, of Kharak Singh, M.A., as Assistant Professor of Agriculture and of a Laboratory Assistant. Negotiations which are in progress may result in one or two posts being filled very shortly, but it is certain that the majority will remain vacant. It was not to be expected that we should find suitable men at once for all the posts, and we may be able to fill the gaps next year. But there is no disguising the fact that we have met with little success, and there is good reason to fear that the original proposals for a higher scale of pay which were supported by the Government of India have been cut down to too great an extent.

Clerical and menial staff for the Agricultural College and the Research Institute.

13. Proposals have been submitted for the entertainment of the clerical and menial staff which will be needed for the Agricultural College and Research Institute, directly the laboratories are ready. Supplementary proposals will follow when they have been worked out.

The buildings of the Agricultural College.

14. Good progress has been made with the Agricultural College. The shell is very nearly finished. There remains to put in floors, permanent fittings, water, gas and electric light, and to complete the drainage scheme and the roads. Detailed estimates have been prepared and, in most cases, sanctioned, for everything except the permanent fittings of the main block. These had to stand over until the arrival of Mr. Milne who is in charge of Botany, Mycology and Entomology, and he had to defer his proposals until he had seen what has been done at Pusa and other Agricultural Colleges. Specifications for these fittings were sent to the Executive Engineer in May. It is greatly to be regretted that owing to the difficulties of the financial situation it has only been possible to allot Rs. 30,000 in the current year for the completion of the College, whereas about Rs. 60,000 more could be utilised if available. It is to be hoped that the Kharif harvest will be such as to enable Government to set free the necessary funds. I fear that our work will be greatly hampered if the Agricultural Chemist and the Economic Botanist are kept out of their laboratories.

Subsidiary buildings.

15. The two additional bungalows have been completed, making 4 in all, including that of the Director of Agriculture, and the Lyallpur water supply has been extended to the Agricultural suburb. Further progress has been made in planting trees. The laying out of the College grounds must, however, be postponed until the workmen are off the premises. The buildings were inspected by the Financial Commissioner in April.

Equipment of the College.

16. Indents for practically all the apparatus and chemicals required by the Agricultural Chemist have been sent to England, and these should arrive during the autumn. The bulk of the apparatus needed for Botany, Mycology and Entomology has still to be indented for, and this will be done shortly.

Date of opening the Agricultural College.

17. The College subordinate staff not having been appointed in time, it was quite out of the question to make a start this year. General questions regarding the curriculum, scholarships, fees, etc., have been submitted for orders. It is hoped that it will be possible to receive classes next July, but this must depend on the progress made with the buildings, and with the recruitment and training of the native staff.

Rewards to officers of the Agricultural Department for qualifying in vernacular languages.

18. Hindustani has been prescribed as the compulsory vernacular for officers of the Indian Agricultural Service posted to the Punjab. But with a view to encouraging the study of the vernacular languages of the Province and increasing the efficiency of the officers of the Department, rewards at the rate of Rs. 250 for the lower standard and Rs. 500 for the higher standard have been sanctioned for Punjabi, Pashtu, Persian and Hindi. It is a condition that no officer shall be permitted to appear in Persian, Pashtu or Hindi until he has qualified by the higher standard in Punjabi.

Issue of printed collections of Departmental Orders.

19. Special orders issued from time to time relating to the officers of the Department, agricultural stations, and agricultural assistants, references to important rules, and consolidated lists of reports and returns, etc., have been collected, re-arranged and printed as Departmental Orders.

Transfer of the head-quarters of the Director of Agriculture to Lyallpur.

20. My office was transferred to Lyallpur on the 17th of February, 1908, on the completion of the new office building. The garden is being planted as an orchard of Malta Oranges.

Account of expenditure against the 4 lakhs grant made in 1905-06. Appendix IV.

21. Appendix IV is a statement prepared under the orders of the Financial Commissioner showing the expenditure of the department year by year since 1904-05, and the amount debitable to the special grant made in 1905 for the development of the department. The accounts of the Civil Veterinary Department are included. The figures for 1904-05 are taken as the normal expenditure before the special grant was made, and the excess over this is debited to the grant after deducting the enhanced income which has accrued to the department. Notes have been given in explanation of certain items. The estimated enhanced expenditure was 4½ lakhs per annum, and the Government of India was asked to provide 3 lakhs, the Local Government finding 1½ lakhs (see paragraph 19 of Punjab Government's No. 426-S., dated 8th June 1905, to the Secretary to the Government of India, Revenue and Agricultural Department). As the Government of India only allotted 2½ lakhs to the Punjab, the total grant per annum is 4 lakhs. The expenditure against this being Rs. 7,03,998 in the three years 1905-06, 1906-07, and 1907-08, there is a balance of Rs. 4,96,002 to the credit of the department. Schemes could not be prepared in time to utilise the grant in full in the first few years. But there will be heavy expenditure in connection with the Veterinary College, the bull-breeding farm and a new agricultural station in 1909-10 and 1910-11 if funds can be made available. The increase in purely recurring expenditure excluding original works in 1907-08 was Rs. 1,56,692. Thus there is still a considerable annual sum available for original works in addition to the balance on the 31st of March, 1908. But this will be less every year as establishment expands and progressive salaries rise, and will be reduced by a considerable sum directly the College staff is recruited.

Part II.—Agricultural Stations and seed Farms.

The Lyallpur Agricultural Station: general. See Appendix I.

22. A brief report on the administration of the Lyallpur Agricultural Station is printed as Appendix I. The area of the station has been increased to 450 acres, and it has been decided that there will be no further extension, this area being sufficient for all purposes. Some 150 acres has been retained under direct management for experimental work, a portion of this being necessarily set aside for the Economic Botanist. The rest of the Farm is leased to tenants on half produce rents, the tenants agreeing to sow our seed and to sell us their share of the produce, if needed, for seed distribution. It is intended also that the tenants' farm should provide an object-lesson in estate management for the students at the Agricultural College. The removal of the slaughter-house has been arranged. The proximity of this building to the experimental plots was the cause of constant injury to the crops on account of the depredations of the dogs and carrion which it attracted.

The Lyallpur Agricultural Station. Wheat experiments.

23. Mr. Howard, Imperial Economic Botanist, continued the enquiry into Punjab wheats, completing his classification, and initiating observations with a view to the selection of the best types. Mr. Howard spent three weeks at Lyallpur at harvest time. In handing over the work to Mr. Milne, Economic Botanist, Punjab, Mr. Howard will furnish us with a complete report embodying the results obtained and his suggestions for the future. We are under a great obligation to Mr. Howard for this very thorough piece of work on the most important of all Punjab crops. Valuable results should follow from this enquiry as well as from the introduction of new wheats from Australia.

The Lyallpur Agricultural Station. Cotton experiments.

24. The work on cotton is being started on similar lines to those adopted with wheat. A collection has been made this year of all the indigenous cottons of the Punjab and North-West Frontier Province, and these will be surveyed and classified, varieties being marked down for selection and hybridisation. Professor Gammie has kindly supplied us with a complete set of his cottons, and these have also been sown. Promising work is in hand with "Dharwar" American cotton, and the Egyptian varieties are being persevered with.

The Lyallpur Agricultural Station. Jute experiments.

25. Considerable interest attaches to the first trial made with jute in the Province. It is evident that the actual growth of the crop presents no great difficulty, provided an adequate supply of water is available. But, if waterings are needed at intervals of less than 14 days as is by no means improbable, it may not be practicable for the Irrigation Department to supply them. There is still some doubt as regards the frequency with which water should be applied, and this point, with others, is being investigated this year. Other important points are connected with the retting of the crop. The retting process occupies about a fortnight in August and September, but takes much longer, and is much more expensive in the winter months. It is, therefore, necessary to know the earliest date on which the crop can be ready for harvesting with a view to the completion of the retting before the cold weather. Further observations are needed with reference to the size of the tank needed to deal with a given area of jute, and the consequence of long delays between waterings. It will be seen that there are many difficulties, and that too sanguine hopes should not be entertained.

The Lyallpur Agricultural Station. Miscellaneous.

26. Useful work has been done in connection with indigo, Russian flax, new fodder crops, beet, and other crops, and in the trial of new implements.

Selection of a site for an agricultural station in Jullundur. Paragraph 20 of the Deputy Director's report.

27. A number of sites were examined by Mr. Milligan in the districts of Ludhiana, Ambala and Karnal, before my return from furlough. But the location of an agricultural station in Ambala or Karnal would not have fitted in with the provincial scheme submitted in my No. 1805, dated the 6th May, 1905, to the Senior Secretary to the Financial Commissioner and generally approved by Government, and I accordingly discussed the question again with the Financial Commissioner when he visited Lyallpur. It was decided that it is desirable to secure a site in the Jullundur district if one can be purchased at a reasonable price, and further that by omitting land for demonstrations and seed-growing on a large scale the area can be reduced without inconvenience to about 100 acres. Land need not be taken up for demonstration purposes, as demonstrations can most fittingly be given in hired plots away from the Farm, and, in the special circumstances of the Jullundur district, seed of selected varieties could be grown on a large scale by private agency. The special objects of the agricultural station will be the study of well problems, of sugarcane, and of other questions connected with the very important agricultural tract of which Jullundur is the centre. The preliminaries for acquisition are in train.

The Sargodha Seed Farm. 1907-08.

28. The year was a failure as regards seed-growing and issues of seed, and this not through any fault of the management. The preceding wheat crop was seriously injured by rust and by unseasonable heavy rain in April 1907, and valuable strains of wheat including Lyallpuri Lal Kasarwali, Australian No. 27, and Baggi of Leiah were lost. The farm had to purchase seed for its own sowings in 1907. An excellent sample of

Australian wheat was obtained from a Lyallpur colonist, but the wheat supplied by him was in no respect up to the sample. It germinated very indifferently, and it turned out to be full of admixture. A few kilas were hand-picked for the Farm for the next harvest, but it is to be regretted that there will be no farm-grown Australian seed for issue. Large areas of Dharwar and Desi cotton were sown for seed in the spring of 1907, but these suffered in the same way as the other cottons in the Jhelum Colony. Owing to plague, it was impossible to carry out agricultural operations at the proper time, and the monsoon was unsatisfactory. The Colonisation Officer, Mr. Smith, C. S., is however a believer in the future of American cotton, and he is persevering with it this year. He urges the necessity for providing improved facilities for marketing (see also paragraph 2 of Appendix II). Eighty maunds of fresh cotton seed were imported from Dharwar, and the whole of this was speedily sold off, most of it in the Colony. Mr. Smith remarks philosophically on the experiences of the two harvests that, "in a bad year such as 1907-08, the Farm at least serves a useful purpose in making clear by actual figures how precarious are the profits of agriculture even in a canal colony."

The Sargodha Seed Farm. Financial results.

29. The expenditure amounted to Rs. 7,006-11-9 against an income of Rs. 7,381. The increase in expenditure is due to extensive purchases of seed amounting to Rs. 3,144, and the purchase of five reapers for demonstration and resale, if possible, at a cost of Rs. 1,250. A new godown and a shed were built during the year. The Seed Farm is exempt from the payment of land revenue and cesses. The sums which would have been leviable under these heads were Rs. 410-14-0 and Rs. 102-11-6, respectively.

The Sargodha Seed Farm. Inspections.

30. I inspected the Farm and audited the accounts on two occasions during the year. It has been a disappointing year, for the Colonisation Officer who has deserved far better results, but it is gratifying to learn that the demonstrations given on the Farm with improved varieties in past years have been keenly followed by the more enlightened of the large grantees, and that many of them have turned the experience of the Seed Farm to their own profit.

Part III.—Demonstrations and other operations connected with Agricultural Improvements.

(a) New and Improved Varieties of Crops.

Operations with American cotton. Paragraphs 1 to 5 of the Deputy Director's Report.

31. Operations with American otton are fully dealt with in paragraphs 1 to 5 of the report of the Deputy Director. American cotton has suffered a set back, but this has been largely due to a serious plague epidemic resulting in great scarcity of labour and poor cultivation in the Jhelum Colony. This was distinctly unfortunate for the experiment in a year when the area sown had made such a marked advance. It was reported last year that satisfactory progress had been made towards the establishment of a market for American cotton, but the withdrawal of Messrs. Sabharwal again left Messrs. Mela Ram alone in the field and they failed to deal satisfactorily with the large increase in the number of cultivators. They were certainly much hampered by the difficulty in obtaining waggons. All available rolling stock was required for the transport of grain to the Districts affected with scarcity, and I had to address the railway authorities in their behalf. But, apart from this, it is clear that something more must be done to facilitate the disposal of the produce, to foster competition, and to secure the full market value of the crop. We are therefore arranging to give a trial to the system of periodical auctions at stated places which has been adopted for Egyptian cotton in Sind. Promising work is in hand at the Lyallpur Agricultural Station with a view to the improvement of the quality of the seed and the elimination of some inferior strains, and the outlook is not unfavourable.

Egyptian cotton. Paragraphs 6 and 7 of the Deputy Director's report.

32. Egyptian cotton has never done well in the Punjab, and the trials in the Rajanpur subdivision have again relegated this variety to the experimental plot. A new variety which does well in the Soudan has been imported from Egypt on the recommendation of the Economic Botanist and it will be seen if it is better suited to Punjab conditions than those previously under observation.

Distribution in districts of seed of selected indigenous cotton.

33. The operations with a view to the improvement of indigenous cotton by the distribution of seed of the best pickings of the best varieties have now been in progress for four years in the districts of Gurgaon, Hissar, Lahore, Lyallpur and Dera Ghazi Khan. The agency employed has been the District or Settlement staff, no other being available. The results thus far have been disappointing except in Hissar, and, on the recommendation of the Settlement Officer of Gurgaon and the Deputy Commissioner of Lahore, I am closing the experiment in those districts. It is reported from Gurgaon that the cotton grown from the selected seed is no better than good cotton grown from other seed. The people were at first quite keen on the experiment but are now inclined to regard it as useless. The Deputy Commissioner of Lahore reports that, owing to press of work, it is impossible for him to find time for the necessary supervision. Mr. Townsend, Settlement Officer of Hissar, is proceeding on two lines and his report is very encouraging. He began an elaborate process of plant selection four years ago, and, this year, he sowed his selected seed on 1 bigha and 2 biswas of land, obtaining an outturn of 3 maunds and 22 seers per kacha bigha as against 2 maunds and 28 seers in 1906. The percentage of lint remains unaltered. I am advising a comparative test next year so as to ascertain if the selection has really resulted in an enhanced outturn; other possible factors are differences in soil, cultivation or season. Mr. Townsend also purchased 100 maunds of the best seed of Bhatla village. This was carefully ginned by Mr. Haupt, Manager of the Hissar Cotton Factory, and the seed was sold to the members of the local Agricultural Society, there being much competition for it. The cleaned cotton fetched 2 annas per maund more than the usual Hissar cotton, and a large parcel would have commanded a still higher price. If the members of the Agricultural Society obtain a higher price for their produce this year, and realise that the excellence of the cotton is due to the selection practised by the cultivators of Bhatla, the result should be to encourage the exercise of care in the selection of cotton seed. In Lyallpur a fresh start had to be made in 1907 owing to the ravages of boll-worm in the preceding years. Hansi white flowered cotton was selected as the best. This is the variety taken up by Mr. Townsend in Hissar. It gives an outturn of 15 or 16 seers of lint per maund and the climate of the colony is favourable to its growth. 79 maunds of seed were hand-picked and hand ginned by three colonists. 30 maunds were returned to S. Mehdi Shah and M. Fateh Din for next year's cultivation on their own estates and 49 maunds were disposed of at the Horse fair durbar. In Dera Ghazi Khan, 93½ maunds of seed of the 2nd and 3rd pickings of "trihai" cotton were gathered and distributed. It is said that there is no appreciable improvement in the produce of this cotton. 51 maunds of Bhatla cotton seed was also distributed, but did not receive sufficient irrigation from the canal. Summarising the results, there does not seem to be much chance of any appreciable success in Dera Ghazi Khan. It is too early to express an opinion on the prospects in Lyallpur, but great care is being exercised by the colonists who are assisting. Hissar is a special case. The Bhatla seed has a Provincial reputation, and it will be interesting to see if an all-round improvement can be established in the district. Generally speaking, I think that our experience in this case shows that it is inadvisable to ask a Deputy Commissioner to undertake operations of this kind unless cotton of marked superiority is available, as he is likely to have a great deal of trouble with very little benefit to the agricultural population. A slight difference in quality and value does not suffice to induce inferior cultivators to adopt careful methods of seed selection. The Bhatla cultivators have, I understand, by methods usually confined to an experimental farm succeeded in breeding a superior strain of cotton. I think we must usually look to the Agricultural Stations to evolve superior varieties. When these are forthcoming, their popularisation will be a comparatively simple matter.

Malta oranges.

34. The orange trees imported four years ago from the Mediterranean and supplied to the Lahore Agri-Horticultural Gardens and the Gujranwala District Board Gardens are now bearing. The fruit is excellent in flavour. Young plants budded from these trees should be available this winter.

(b). ENTOMOLOGY.

Boll-worm.

35. In last year's report, the view was expressed that the cotton crop of 1907 would probably be free from boll-worm, and this forecast proved to be correct, boll-worm being extremely rare. The winter of 1906-07 was a mild one and the history of the year furnishes strong evidence in support of Mr. Lefroy's theory that the outbreak in 1905 was due to the exceptionally severe cold of January and February in that year which practically annihilated the important parasite which normally keeps boll-worm in check. The opposite theory, that the spread of boll-worm is connected with the part failure of the monsoon, was falsified by the fact that the monsoon current withdrew very early indeed in 1907. The study of boll-worm and its parasites was continued and valuable information was obtained as to the plants on which boll-worm lives during the winter and spring, and the extent of the prevalence of boll-worm and of the various parasites in the different months of the year. The entomological assistant devoted a great deal of his time to this subject.

Other entomological work.

36. An outbreak of insect pests on lucerne on the Army Remount Farm at Sargodha in May was visited by the entomological assistant and practical remedies were successfully applied. Other insect pests which were studied included brinjal hairy caterpillars, sugar-cane borers, two spotted hairy caterpillars on fruit trees, fruit flies, toria and senji aphis, wheat aphis, senji beetle, green pea pod borer, mealy bugs on fruit trees in Lahore, diamond back moth on cabbages, and mustard bug. Remedies were tested in some cases; in others, life histories were worked out. When the section is developed, its chief aim will be to devise means of destroying harmful insects. Good work is being done in arranging the collection of Punjab insect pests and in collecting information for teaching purposes.

Ear Cockle in wheat.

37. Considerable alarm was caused in April by the report of a new disease in wheat at Chak No. 124, Rakh Branch in the Lyallpur District. The case was taken up by Mr. Milne, Economic Botanist, who identified the disease as ear cockle (tylenchus scandens). He found that it had destroyed ¾ of the crop on an area of 5 kilas and was very destructive in a large area of the wheat crops in the neighbourhood. The disease had never been reported before in the Punjab, and was believed to be unknown in India, although it has recently been ascertained that it is referred to in Fuller and Duthie's "Field and Garden Crops." Measures were at once taken to isolate the affected crop. Information of the outbreak was sent to all Deputy Commissioners with samples of diseased ears of wheat. This soon elicited the information that the disease although not previously understood or even noticed in most places, is to be found in many parts of the Province. It has now been identified in 12 districts. Mr. Milne considers that the evidence points to the assumption that the disease has been many years in India and is perhaps indigenous, but that it only becomes excessively virulent in exceptional circumstances. Mr. Milne writes as follows :—

> "Proper cleaning of the *bhusa* and seed by winnowing and sifting; the destruction of galls left on the threshing floor, by burning in some bhusa; and the introduction, where necessary, of a rotation where wheat crops do not follow each other in rapid succession will, I think, keep the disease in check, or, if efficiently done, exterminate it. Information on how to deal with the disease has been issued to all Deputy Commissioners and they have been asked if they will kindly assist us to ascertain the extent of the damage it usually does in the wheat crop."

(c). AGRICULTURAL MACHINERY.

The introduction of Reapers.
Paragraphs 8 to 13 of the Deputy Director's report.

38. There is very little to add to Mr. Milligan's complete summary of the work done in connection with reapers. The outlook is very encouraging, and Mr. Milligan's experience is being utilised by his deputation on duty in England for 3 weeks while he is on privilege leave, to enable him to arrange for an improved reaper. The "Thistle" reaper and mower which was used this year did extremely well, but there are a few details which can be simplified or altered with advantage.

Sugar-making demonstration at Bungah, Paragraphs 14 to 17 of the Deputy Director's report.

39. Owing to the unavoidable delay in starting the sugar-making demonstration and the poor quality of last year's canes, the sugar-making plant did not have a fair chance; at the best, the results may be regarded as inconclusive, but they are not promising. Mr. Milligan's detailed report is under consideration and will be submitted to Government with my recommendations. The comparatively small percentage of sugar in the juice of Punjab-grown canes makes it appear probable that it will be necessary to continue the experiment at the Lyallpur Agricultural Station, where a sufficient area of sugarcane is being grown for this purpose, and where assistance will be available from the Chemist's Laboratory. If this course is adopted, steps will be taken to test the percentage of sugar to juice in the principal sugar-growing districts, and other information will be collected.

Planet Junior Horse Hoe. Paragraph 6 of Appendix I.

40. The use of the "Planet Junior Horse Hoe," an American machine, which costs about Rs. 50 has resulted in great economy in making ridges for the cultivation of vegetables, sugarcane and cotton. The Horse Hoe seems likely to find favour with the agricultural population, and seventeen have been ordered by the Department for private persons.

Winnowers.

41. There is a great demand for a winnower, but all attempts to devise a suitable machine, have failed up to the present. Messrs. Marshal and Sons sent two types of English winnowers to Lyallpur this spring, but neither of these gave satisfaction, as they were not constructed to separate the very large proportion of "bhusa" found on the Indian threshing floor. Mr. Milligan having experimented with various winnowers in India has asked for permission to get machines made in England according to his specification, and I have authorised him to buy likely winnowers up to Rs. 1,000.

Steam Threshers.

42. It was decided not to buy a steam thresher last year as a machine tried at Rashida on the Sidhnai canal had not been a success, and the thresher purchased for Pusa, although well reported on in dealing with oats, had not been used for wheat. Experiments have been made with wheat at Pusa this year and the results of these are awaited before we commit ourselves to the purchase of this expensive item. The Inspector-General of Agriculture has very kindly repeated his offer of Rs. 5,000 towards this object.

Well-gears.

43. Attention has been given to the question of improved Persian water lifts. There is a mistri at Ferozepore who has, under the direction of Major Barton, Deputy Commissioner, made a gear which raises 2 or 3 times as much water as the ordinary lift and with the same power. A firm at Gujranwala has moved in another direction, and is aiming at lifting the normal quantity of water with one bullock instead of two. This result is to be obtained by the application of ball bearings at the points of friction. I saw another ingenious arrangement for reducing friction at Rawalpindi. The enquiry is in the hands of the Deputy Director and will be continued next cold weather. The drawback to these improved lifts is their heavy initial cost.

Concession of the North Western Railway in the carriage of reeaprs.

44. With a view to placing every possible facility in the way of the introduction of agricultural machinery, the North Western Railway has very kindly agreed to reduce their rates on reapers and mowers.

Part IV.—Miscellaneous.

Enquiry into reh. Paragraph 18 of the Deputy Director's report, and Paragraph 4 of the Agricultural Chemist's report.

45. The enquiry into reh has proceeded as far as is possible without a chemical laboratory. The Deputy Director and the Agricultural Chemist have visited and inspected a large number of typical cases of reh in the Chenab Colony, and have also seen the principal reh tracts in the Province. Observations of the subsoil have been made and soil specimens have been collected for analysis. A special reh map of the Chenab Colony has been prepared in the Office of the Deputy Commissioner of Lyallpur. The Inspector-General of Agriculture made a short tour in the Chenab Colony last autumn in connection with this subject and, with his concurrence, it was decided to defer field experiments until the chemical laboratory is ready.

Castor cake as a manure.

46. It was brought to notice about four years ago that castor cake was being sold by the Punjab Oil and Flour Mills at Lahore to cultivators on the west coast of Bombay as a manure for sugarcane. So, with a view to ascertaining if castor cake might not give remunerative results when applied to sugarcane and vegetables in this Province, a free distribution was made to a few selected zemindars in the Lahore and Amritsar districts. As a consequence, the use of castor cake is gradually extending in the Lahore district, and purchases from the Punjab Oil and Flour Mills have increased each year. No progress has however been made in Amritsar. A further distribution is being arranged for in some districts in which valuable crops are grown,

Sericulture.

47. The subject of sericulture has been under the consideration of the Provincial Government, in view of the remarkable success obtained in Kashmir. In Kashmir, as in the Punjab, many attempts to establish a silk industry had failed owing to disease among the silkworms. But the use of imported disease-free eggs in Kashmir has at last placed sericulture on a sound basis, and the silk industry now provides employment for thousands of families besides being extremely profitable to the State. Climatic and other conditions are very probably not as favourable in the Punjab as in Kashmir. One great danger in this province consists in the sudden advent of very hot weather in early April, this being fatal to the worms if cocoons have not been formed in time. Another cause of loss in the past has been the neglect of sanitary considerations in handling silkworms. But the mulberry tree grows extremely well with irrigation and is fairly common, and an experiment will now be undertaken in the Gurdaspur district, the Simla Hill States, and at Changa Manga to determine if the use of disease-free eggs will remove all serious difficulties in the way of silkworm rearing. The places selected are typical of the submontane districts, the lower Punjab hills and the plains. Disease-free eggs will be supplied gratis to rearers on condition that they return all cocoons. These cocoons will be sold to the best advantage and the price realised paid over to the growers. Arrangements are also being made to secure the services of a few experienced Kashmir growers for instructional purposes in the care and treatment of silkworms.

Agricultural Associations.

48. The Lyallpur Agricultural Association met twice as usual under the Presidentship of the Deputy Commissioner. The subjects discussed covered a wide field and valuable information as well as practical assistance were obtained from the members. The Hissar "Townsend" Agricultural Association now has four camel stallions at stud as against one last year. The purchase money of these camels was subscribed by a few of the wealthier members of the Association. Samples of bajra have been imported for trial from Rawalpindi, Bombay and the Central Provinces. The Lyallpur Bar Zamindar's Association evinced great interest in the introduction of reapers purchasing 10 for their members. The Honorary Secretary, Sardar Jiwan Singh, has been specially mentioned by the Deputy Director for the valuable practical assistance which he rendered. A paper on labour-saving agricultural machinery was read by the Manager of the Lyallpur Agricultural Station at one of the Meetings of the Society.

Shows of agricultural produce.

49. Shows of agricultural produce and implements were again held at Lyallpur and at Muktsar in the Ferozepore district, and Major Lowis, Deputy Commissioner of Ambala, inaugurated a show at Ambala. The Manager of the Lyallpur Agricultural Station was deputed to assist at these shows. There was fairly keen competition at Lyallpur and Muktsar, but the Ambala show was regarded with considerable suspicion as a device for ascertaining what could be grown in the district prior to the commencement of settlement operations. Demonstrations of the "Junior Planet Horse Hoe" were given at Lyallpur and Muktsar.

Remarks on the extension of agricultural associations and shows.

50. The agricultural associations and shows referred to above are serving a useful purpose and are of special value as pioneers, but I would not recommend their rapid extension. In meeting the members of Agricultural Associations, it is desirable that the officers of the Department should be able to speak with authority on local problems, and should have practical suggestions to put forward. But preliminary enquiries and experimental work on farms are needed before this stage is reached whereas the Department is still in the early stages of recruitment and organisation. The Lyallpur and Hissar Associations are special cases, and the former has the advantage that there is an Agricultural Station in the district. The first associations should be in districts in which agricultural stations are established, or in which special work is in progress. I anticipate that District Associations will be extremely useful, if not indispensable, later on.

District gardens.

51. The accounts for the year ending March 31st, 1908, of the four gardens noticed annually in this report are as follows:—

	Income.	*Expenditure.*
	Rs.	Rs.
Shahdara	2,098	4,027
Shalamar	2,200	2,425
Kudsia	1,002	2,140
Roshanara	2,134	2,587

The Mahasu orchards.

52. The arrangements for the management of the Mahasu orchards and the issue of young fruit trees for fruit culture in the hills remain unchanged. Applications were received for 5,602 plants, and 3,119 were actually supplied.

Monthly press notes.

53. A monthly note has been sent to the leading English and Vernacular papers dealing with the agricultural situation and matters of interest connected with the Agricultural and Veterinary Departments. The result of this is to keep the public informed of the progress of the work, and several enquiries have been received on subjects referred to in these communiques.

Proposed new lines of work.

54. New lines of work which are being taken up include fresh experiments with cassava to see if any varieties can withstand the dryness and cold of the Punjab; the trial of new varieties of fruit and of various methods of fruit growing; the tentative employment of well-borers to make trial borings; surveys of districts in which well irrigation is being carried on with a view to possible extensions, and the improvement of poultry.

Conclusion.

55. My special thanks are due to the Inspector-General of Agriculture, who visited the Province on two occasions, to the members of the Pusa staff, and to Messrs. Townsend, Settlement Officer, Hissar, and de Montmorency, Deputy Commissioner of Lyallpur, for the valuable assistance given by them to the department during the year.

W. RENOUF, C.S.,
Director of Agriculture, Punjab.

APPENDIX I.

ANNUAL REPORT ON THE ADMINISTRATION OF THE LYALLPUR AGRICULTURAL STATION, FOR THE YEAR 1907-08.

1. During the year under report the area of the station has been increased to about 450 acres.

2. Arrangements have been made for the erection of a weigh-bridge at the Farm and of a travelling pulley in the seed godown.

3. Some difficulty having occurred in obtaining the fair share of water from the water-course supplying the Farm, the Canal Department have agreed to submit estimates for a scheme reorganising the supply so as to bring it almost entirely within the control of the Farm.

4. The difficulty of obtaining good wheat seed for sowing in the autumn of 1907 led to a considerable demand for farm seed which was distributed to the extent of 411 maunds.

5. Having regard to the fact that one of the most useful functions of the station should be to supply pure seed of known qualities to cultivators and to the fact that hitherto no single-typed variety of any important crop has been available for distribution, the experimental work has almost been confined to the following lines :—

(*i*) The isolation of types of wheat and cotton by growing seed from single plants separately.

(*ii*) A practical trial of a system of comparison of outturn of varieties by growing them on land previously tested as to fertility.

As regards the former Mr. Howard has concluded his work on the Punjab wheats with the isolation of some 25 types, the best of which after a few years' multiplication should be available for distribution with accurate information as to the several qualities for which they are valuable. Preliminary work on the introduced wheats and on cottons was begun by the Manager in 1906-07, and in the year under report seed from some hundreds of selected plants was sown in separate rows so as to enable a survey of as many variations as possible to be taken. This work has now been taken over by the Economic Botanist.

6. Of the machinery tested, a reaper of a different type from that previously tried was found to have some decided advantages in principle, and the Deputy Director expects to obtain a machine in England which embodies the best points of both.

After continued trials, an American Horse-hoe was successfully applied to making ridges on which to grow crops, and a demonstration organised by the Director resulted in the ordering of 16 machines through the Department.

7. Credit is due to Abdul Rahman Khan, Farm Manager, for the care and skill with which he has attended to the experimental work. He has proved himself an accurate and conscientious worker.

8. The expenditure for the year ending March 1908 was Rs. 9,195-2-3 and the income Rs. 4,424-11-6 as against Rs. 7,564-5-10 and Rs. 1,969-11-6 for the year 1906-07. The increase in expenditure was due to extra labour employed in laying out and levelling land for experimental plots and to increased purchase of implements and of tenants produce. The increase of income was due chiefly to the sale of greater quantities of farm produce at enhanced prices.

A. C. DOBBS, PRINCIPAL,

Punjab Agricultural College.

APPENDIX II.

ANNUAL REPORT OF MR. S. MILLIGAN, M.A., B. SC., DEPUTY DIRECTOR OF AGRICULTURE, FOR THE YEAR 1907-08.

Distribution of American Dharwar cotton seed in the Jhelum Colony.

1. As stated in my last year's report the area sown with American cotton had doubled itself within a year, but fears were expressed for the success of the crop in the Jhelum Colony owing to the exceedingly bad preparation of the land. Unfortunately, these fears proved to be only too true. Along with all other kharif crops in the Jhelum Colony the acclimatized American cotton suffered severely. A series of misfortunes visited the colony during the growth of the crop. The prevalence of plague interfered with ploughings, delayed sowings and made weeding impracticable. Locusts did a great deal of damage to the early-sown cotton. The monsoon yielded practically no rainfall, and the matured crop was attacked by a plague of rats, which did enormous damage. I am inclined to think that the question of canal water scarcity was greatly exaggerated, and that the true cause of the droughting of the crops was the bad preparation of land before sowing. The final outturn of the American cotton was, as was to be expected, low and compared badly with that of the *desi* varieties which are of course much hardier in a bad season. Our estimated yield of American cotton (unginned) was 2½ maunds, as compared with 4 maunds of *desi* in plots growing alongside. It is estimated that the growing of the American variety represented a loss of Rs. 6-7-0 per killa as compared with *desi*.

Arrangements for the sale of American cotton.

2. Two firms entered the field for the purchase of the produce, Messrs. Mela Ram, Lahore, and Sabharwal, Lyallpur, offering the same terms as last year, *viz.*, a premium of Re. 1-8-0 per maund over *desis* with the usual additions and deductions if the quantity of lint per maund of uncleaned cotton was over or under 12 seers. An attempt was made to induce the growers to send their produce to the markets at Sargodha and Bhalwal, instead of having it purchased in the villages. This attempt, however, failed, and Messrs. Sabharwal left the field entirely to Mela Ram and Co. Messrs. Mela Ram and Co. has given the Department a good deal of support from the outset in finding a market for the American cotton; but this year I regret to state the arrangements made were far from satisfactory, as their purchasing agents were exceedingly slow in buying up and taking delivery of the cotton, thus causing a good deal of dissatisfaction amongst the growers. They explained that this was due to the difficulty in obtaining waggons at the Railway Stations. Be this as it may, a more satisfactory solution must be found for the disposal of the produce, which is a very important item in the operations.

Area sown in 1908 in the Jhelum Colony and future prospects.

3. As was to be expected, the area sown this year, 1908, has greatly diminished, having fallen off from 2,000 to 440 killas. However, it is gratifying to note that the number of growers has not diminished in anything like the same proportion, and that we still retain almost to a man all our customers of over a year's standing. In the face of last year's experience this is a tribute to the staunchness of our many supporters, and is distinctly encouraging. On the whole the scheme is on a sounder footing that it has yet been. We have imported entirely fresh seed this year and have got rid of many growers who were quite unfitted to cultivate improved varieties. We have also refused to guarantee anything about the water supply which I consider perhaps the best move of all, thus getting rid of what was certainly an inducement to grow, if not actually a bounty on, American cottons. I have put up a scheme for the disposal of the produce by auction, which, I hope, will be sanctioned as I am sure that better prices will be thus obtained. These precautions and alterations adopted, the scheme should rest on a commercial basis and should stand or fall on its own merits.

American cotton in the Lyallpur district.

4. The growers in the Lyallpur district were not so severely hit, although they reported a diminished outturn. The amount of seed sold in this district this year, 1908, represents an area of 142 acres as against 260 last year. But the actual acreage under the crop is much greater, as a good many of the old customers are using their own seed. The growers have been for the last two years disposing of their produce locally at rates equal to those given by Mela Ram in the Jhelum Colony. We are not pressing American cotton in the Lyallpur district as we have a sufficient connection to expand its cultivation indefinitely when the proper moment arrives. Owing to the backwardness of the work on cotton at the Lyallpur station, the true policy seems to be to avoid sudden expansion until the selections, crossings, etc., have produced some definite result. We are quite prepared to advance to a large area when a type more suitable to the country has been produced.

Assistants employed on work connected with American cotton.

5. Two agricultural assistants were last year detailed for touring work in the Jhelum Colony in view of the increased area. Their employment was, I consider, entirely justified as the work was exceedingly heavy during the most trying months of the year.

Trials of Egyptian cotton at Rajanpur.

6. Trials of Egyptian cottons at Rajanpur have met with little success. These trials were initiated in the hope that the presumably longer season at Rajanpur would enable these cottons to attain to their proper maturity. The difficulty at Lyallpur has not been one of the successful growth of the plants, but of their late ripening and consequent liability to frost. Fifteen plots with an aggregate area of 5 acres were grown at Rajanpur, Fazilpur, Shikarpur, Bruceabad and Kot Mithan. The crop was thus well distributed over a large tract of country. The land on which the seed was sown was in general of good quality except at Bruceabad. As the crop requires to be sown early, it had to be grown on land irrigated by wells. Sowing was done under the supervision of Ijaz Husain, Agricultural Assistant, according to our most approved methods, and we were successful in obtaining a good germination all over. Although the crop flourished well in its early days, it began seriously to fall off in July and August. Plot to plot reports by the Agricultural Assistant showed the gradual failure of one after another of the trial areas. On my visiting Rajanpur in November, I found that with the exception of four plots the rest were absolute failures. These four plots gave promise of some yield which, however, finally was a very small one. The same old difficulties as have given trouble at Lyallpur have again appeared. The crop was late, later than at Lyallpur even. The bolls opened very badly and produced only a small quantity of lint of an inferior quality.

Trials of Egyptian cotton at Rajanpur.

7. It is at once apparent that there is something with regard to the growing of Egyptian cottons outside the mere question of length or shortness of season. The questions both of food and water requirements are not properly understood. It is evident that the crop requires good cultivation and liberal manuring for the production of a decent stand. But over-manuring produces a top-heavy crop. Again if given too much water it overgrows itself, and a very slight droughting causes a rapid shedding of the leaves. It is quite evident that the whole crop requires detailed study at the experimental stations with reference to these and other factors. We have, therefore, resolved to drop the trials at Rajanpur for a year or two, until these questions have been satisfactorily settled.

Introduction of reapers.

8. Satisfactory progress falls to be reported with regard to the introduction of reaping machinery, and the Department may fairly claim to have clearly demonstrated, on a sufficiently large scale to discount accidental circumstances, the economic value of machines in the harvest field. The purchasers, on the other hand, have equally proved that with a little expert help at the outset they are sufficiently intelligent to manage a simple type of machine. The adoption of reaping machines on a fairly large scale would doubtless sufficiently ease the labour market in normal years to allow of a substantial shortening of the reaping season in the colonies. The moral effect should be no less in importance, as the use and care of machinery has perhaps no equal as an educative force in an agricultural community. Moreover, the placing of a sound investment in the hands of the cultivator, combined with practical help such as has been given this year, is perhaps the surest, and is certainly the readiest method of popularizing the Department.

Distribution.

9. Briefly stated, this year's operations are as follows :—

Fifty-two machines were indented for as under :—

For Demonstration purposes.	For district Boards	19
	For the Canal Department	5
	For the Colonisation Officer, Sargodha	5
For private persons		23
	Total	52

These were distributed as under :—

In the Chenab Colony	27
In the Jhelum Colony	10
Other districts	15
Total	52

The classification of other districts is not arbitrary but made because the original scheme was to establish reapers in the canal colonies. Out of the 52 machines 20 were seriously damaged in transit. We were able after great difficulties and with the timely aid of the canal workshops, Amritsar, to completely repair every machine. Although we had to meet a bill of Rs. 350 for repairs, we will be able by other economies to hand back a few rupees per machine out of the Rs. 250 called for from purchasers.

Assistance given to purchasers.

10. It was evident that the Department would have to give a good deal of practical assistance to purchasers in the way of training, etc. The following arrangements were made :—

(a). Classes of practical instruction were held at the Agricultural Station during the fair week in March, and all purchasers were asked to send at least one man for instruction. These classes were well attended and effected, I consider, good results.

(*b*). Written instructions in the vernacular were circulated to all purchasers, giving a few practical hints as to the care and use of machines, organization of labour, etc.

(*c*). Arrangements were made to give practical assistance to as many purchasers as possible by visiting their villages at the beginning of harvest. Owing to the small available staff at Lyallpur it was resolved to concentrate our attention on the Chenab Colony. One Assistant was already stationed at Sargodha in connection with the American cotton. He was detailed to give all the assistance he could there. For the other districts a mistri was held in readiness at Lyallpur to proceed instantly to any outside district when called for. Our decision to concentrate our efforts on the Chenab Colony was completely justified by the results obtained there. Many of the purchasers required a good deal of assistance and encouragement at the outset, but finally, with one exception, where the owner could not be got to take a personal interest in the matter, complete success fails to be recorded.

Results in the Chenab Colony.

11. Out of the 27 machines indented for for the Chenab Colony, it should be mentioned that 6 were not used by their purchasers owing to, in two cases, their crops being destroyed by hail, and, in the remaining 4, their owners imagining that the abundant labour supply consequent on the shortage in area under wheat in other districts would put machine-reaping at a discount. This, however, was by no means the case, as having regard to the dearness of wheat, the labourers being paid in kind were receiving the value of 12 or 14 annas per day. Machine-reaping will pay when labour is at 6-7 annas per day or Rs. 2-2-0 per killa. Out of the 21 machines actually in use in the Lyallpur district, I have obtained trustworthy figures as to area cut in 18 cases, the average being 68·6 killas. As our estimate of the annual cutting area was put at 70, and as the reaping season was exceptionally short this year, the figure attained is eminently satisfactory. Our other estimates were very near the mark, although the actuals for breakages were only Rs. 2, against an estimate of Rs. 15, which is again satisfactory.

Results in other districts.

12. The machines in the other districts being all bought for demonstration purposes were not used on a commercial scale. I regret that in many cases they did not prove satisfactory. There are a number of reasons for this. Amongst the chief are :—

(*a*) The lack of the personal element of ownership, which goes far to spell success.

(*b*) Their use on absolutely unsuitable land, *e.g.*, on lands irrigated by wells and loose sandy soils.

(*c*) The impossibility of our Department giving the necessary help at the outset which proved so valuable in the Lyallpur district.

Further prospects.

13. I have little doubt as regards the ultimate success of machine-reaping, provided due attention is paid to several details. It is first of all necessary to get the financial arrangements put on a commercial scale to allow the Department to devote its attention to the educational side. I have already obtained the promise of a well-known importing European firm to act as distributing agents to any home firm supplying a machine according to my design. As I hope to get a machine suitable in all respects for the colonies, I expect to have the whole question put on a sound commercial basis for next year. I think there is a good opening for contractors working machines, reaping at certain rates per killa, and probably this will be the soundest method of introducing such machinery. This method provides in a perfectly businesslike manner the demonstration of machinery, which would otherwise fall to the Agricultural Department. I shall, therefore, assist contractors as much as possible in providing for practical instruction, etc., for them. Again, a steady, though possibly slow, advance is preferable to a sudden expansion, and care should be taken to avoid any dissipation of our energies over wide areas.

Sugar-making demonstration at Bungah.

14. Under the order of Government an exhibition of the sugar-making plant used in the United Provinces by Mr. Muhammad Hadi was given at Bungah. Unfortunately the training of one of our assistants by Mr. Hadi was delayed owing to the unfavourable season. In consequence of this, we were unable to make a start before February and this only left time for a month's work. Great difficulty was experienced in arranging for good cane owing to the season being so far advanced and full prices had to be paid for juice containing abnormal quantities of molasses. The exhibition was fairly well patronized, some people coming long distances to see the plant working. From an economic standpoint, however, it was far from being a success, and several disturbing factors appeared, which make it at least doubtful if sugar-making as opposed to gur-making can ever hope to pay on any scale in the Punjab under present conditions. The demonstration was carried out with the object of showing in a practical manner that Government desired to encourage sugar-making in the Province. Mr. Hadi's figures showed that he was able to work the plant in question at a profit in the

United Provinces, and it was decided that his plant should be exhibited in the Punjab. It has been evident all along, to those who understood the question, that Mr. Hadi's figures would not hold in the Punjab. Take, for instance, one important item, the cost price of the raw material, *viz.*, the juice. Mr. Hadi (*vide* Bulletin No. 19, Department of Agriculture, United Provinces) buys his juice at 8 annas per maund. The Punjabi sugarcane grower manufactures gur, the price of which has been Rs. 5 for some time back. Deducting Re. 1 for expenses of boiling he, in reality, gets Rs. 4 for his gur in terms of juice. The average gur to juice rate being from 18 per cent., to 20 per cent. he thus gets from 11·5 to 12·8 annas per maund for his juice, an average of 12 annas. Similarly, the labour rates quoted in Bulletin No. 19 are at least 30 per cent. to 50 per cent. below those of the sugarcane districts of the Punjab. These two items, *viz.*, the price of juice and the cost of labour were pointed out by me when the scheme was first mooted, as affecting Mr. Hadi's calculations materially.

Apparent low percentage of sugar in cane juice in the Punjab.

15. Another item, *viz.*, the sugar contents of the juice, had not been cleared up. As the main product of sugar-making as distinct from gur-making is cane sugar, the percentage of this material in the juice is all important. On the other hand, in gur-making it is of lesser importance as it affects the quality only and not the weight of the final product. Would then the comparative non-existence of sugar-making in the Province not depend on the fact that the raw material of the trade which fetches a high price for other purposes contains too small a quantity of sugar to make it possible to extract it with profit? This year's figures would seem to at least point in this direction. It must be remembered, however, that the year in question was a bad one for sugarcane and that the figures obtained can only be accepted as an indication of what may be expected in a bad year. Mr. Hadi puts his average sugar to rab percentage at 46. At Bungah we only succeeded in obtaining 24 per cent. I am satisfied that the operations were carried out properly and according to Mr. Hadi's methods. In order to satisfy myself on this point I asked Mr. Hadi to send one of his senior assistants in charge of the Meerut operations to visit Bungah. He reported that everything was being done that could be done, and that the boiling and sugar-making were being carried out satisfactorily. I attribute the bad quality of the juice to the bad season, insect attacks and frost. Now although bad seasons do not occur every year, frost is an almost annual occurrence. The precise injury done by frost has not been investigated, but it is a well-known fact that the little sugar-making that is done, is done in the early part of the boiling season. This is, I consider, very significant; for the cultivators and *kand-saries*, though quite unable to explain things, have a wide empirical knowledge of the subject.

Consequent loss on the demonstration.

16. The operations then could not be hoped to pay their way. In fact a defici of Rs. 538 falls to be recorded. This would have been greater had the produce not been disposed of at high rates. The total amount of sugar and molasses not being great were retailed by the agricultural assistant in charge, the prices obtained being Rs. 12 and Rs. 3-7-0 per maund. Had the produce been sold wholesale, the sugar would have had to come into direct competition with Behar-imported sugar at Rs. 10-8-0 per maund.

Need of further investigation before further demonstrations are undertaken.

17. I have gone into more detail than space really permits, as I hope that demonstrations may be discontinued until the question has been thoroughly worked up at one of the Agricultural Stations. We have really touched the fringe of a great economic problem, which has proved difficult to solve in every sugarcane-growing country. The Punjab, in addition, has conditions more or less peculiar to itself. Although I am not sanguine of success, there are one or two points which hold out some promise. These are the comparatively higher prices obtained for molasses here and the possibility of the sugar to juice ratio being considerably higher on an average than we have been led to expect from this year's figures. The problem is one which really belongs to an Agricultural Station, where all the varying factors can be properly estimated and averaged.

Reh in the canal tracts.

18. Practically no progress has been made in the investigation into *reh* in canal tracts owing to the want of a chemical laboratory. I have inspected some more typical soils, which have confirmed the opinions I expressed last year on the subject. Given good sub-soil drainage the remedy for *reh* seems to be in the hands of the Irrigation Department. The more serious question of land initially fertile becoming reh-infected after several years' cultivation requires careful study, as no work has apparently been done on this particular aspect of the case. It has been agreed that preliminary chemical work is absolutely necessary for approaching the subject with any hopes of success. The Department is ready to begin work immediately the chemical laboratory is opened. The subject is one of the most important on the programme of the Department.

Enquiry into fodder scarcity in the south-east Punjab.

19. A preliminary investigation with regard to the question of fodder scarcity in the south-east Punjab has been inaugurated this year. But, owing to pressure of other work and the weakness in the numbers of the subordinate staff, the matter could not be taken up before May when a beginning was made in the Rohtak district.

Selection of a site for an Agricultural Station in Jullundur.

20. The site chosen by me for the proposed new Agricultural Station near Jullundur Cantonment having been rejected on the ground of its expensiveness, the whole work of selection had to be gone over again. We received orders to visit sites in Ludhiana, Ambala and Karnal. In accordance therewith, last hot weather, I tentatively recommended a choice of sites in Ambala and Karnal. These again were ruled out of Court though being too far from Jullundur. I again selected a site three miles from Jullundur City on the Nakodar Road, and it is to be hoped that the purchase of this site will be sanctioned. The site is far from being ideal; but it is the best we could get for the money, and possesses facilities for the study of several of the more important problems of the district. It does not follow that good land in the best of condition is the best for experimental purposes. The land of the site in question is admittedly poor, but is possibly better suited for the study of not only particular problems but general principles than any Government Farm I have seen in India. The cost of the site should not exceed Rs. 30,000, but the annual budgets will necessarily be fairly high for a few years until the station is properly laid out.

Miscellaneous.

21. The main lines of my work have been as above stated. Space does not permit me to mention the numerous smaller points more or less unimportant. Outside correspondence has fallen off somewhat during the year, but an increasing tendency has been manifested for correspondents to make personal calls on the Officers at head-quarters and to seek advice at first hand.

APPENDIX III.

ANNUAL REPORT OF MR. BARNES, B. Sc. F.I.C., F.C.S., AGRICULTURAL CHEMIST, PUNJAB, FOR THE YEAR 1907-08.

Preliminary.

1. The past year has not been characterised by any work of a Chemical nature and it is a matter of some regret to me that there is no work of this type to record, but, though very little special work has as yet commenced owing to the want of a laboratory and apparatus, nevertheless, this want has left my hands free to deal with a large amount of important preliminary work, and even had I been installed in my laboratory the bulk of my time must have been taken up in dealing with these matters. The most important points I have been brought in contact with during the past year have been matters connected with the College such as the installation of gas, electricity, drainage, etc., the selection of the assistant staff, the field examination of typical alkali soils of the Punjab and the commencement of retting experiments on jute and flax.

Retting of Jute and Flax.

2. Towards the end of last summer the question of the valuation and disposal of the Jute and Flax Crops arose and I proposed to the then acting Director of Agriculture to undertake some retting experiments on the former. These of necessity were entirely of a field nature as I had no means of carrying the investigations into the laboratory, the place where the experiments would have started in the ordinary course of events. During the whole of the cold weather I carried out the retting of samples of Jute grown on the Lyallpur Farm last season and sent some specimens of the resulting fibres up to Calcutta to Messrs. Birkmyre Bros and the India Jute Association for commercial valuation. The reports I received were of a very gratifying nature and led me to believe that the subject was one which offered some prospects of success in canal-irrigated districts. Hitherto it has been customary in Jute-growing districts to ret immediately after reaping but I found that it is possible to dry and stack the Jute stems before retting without materially impairing the value of the fibre. This I consider a point of some importance from an economic standpoint as it will enable the cultivator to choose the most convenient time to deal with the retting. The experiments so far undertaken have been of a very sketchy and preliminary nature, and I have recommended that they be continued, expanded by aid of laboratory investigation, for another two years, and that during this period various varieties and methods of cultivation be tested on the farm. By that time I think we shall be in a position to definitely advise the adoption or rejection of Jute as a Punjab crop.

Departmental pamphlets on applied chemistry.

3. In connection with the subject of retting I was led to believe that a series of departmental pamphlets on the general methods in use for the separation of materials of economic value from agricultural raw materials, might prove of great help to the agricultural assistants and other members of the department interested in the industrial application of Chemistry and I suggested that I might issue a series of such pamphlets for the use of members of the department. I also propose to give a series of lectures from time to time on the same subject for the benefit of senior students of the College and junior members of the Department.

Investigation of Reh.

4. I have spent a considerable portion of the past year on tour, having travelled 6,668 miles by rail and 448 miles by road, making 7,116 miles in all, and the main object of all, or nearly all these journeys has been the local inspection of Alkali infected soils, with a view to taking up the problem in the laboratory as soon as possible. I have, in the course of these inspections, collected a considerable amount of material which will be of the greatest value to me in the chemical investigation of the problem. The whole question of Reh appears to me to be of primary importance and one well worth spending the resources of the Department upon. At a meeting of the Inspector-General, the Director of Agriculture, Deputy Director of Agriculture and myself held late last autumn, it was decided to delay any field experiments until we had gained more knowledge of the constitution, either fixed or variant, of the Alkali lands of the Province, and afterwards to base our field experiments on such knowledge. I fully endorse this policy which I am convinced is the best way and the one most likely to yield satisfactory results. As soon as I am provided with laboratory accommodation I shall start working on the material I have collected in my tours and shall as far as possible subordinate all other laboratory work to this one object. Early this summer I made a tour in the Hissar district to inspect the salt wells which were reported to me by the Deputy Commissioner as being a source of distress to the population, I was unable to say from a casual inspection whether anything can be done to sweeten these waters, as any such cure depends upon the composition of the salts causing the bitterness. Samples of the water were taken in typical cases and will be subjected to examination as soon as possible.

Record work.

5. The record work of Agricultural Chemistry and its problems has been started and the American Card Index system is to be shortly introduced. The use of this will prove of great assistance to me in facilitating my work by the construction of an Index to the literature of Agricultural Chemistry. It will also make for future reference a clear and concise record of all the Chemical work of the Department.

Purchase of books.

6. Library books to the value of the Rs. 1,498-1-7 have been received from Messrs. Bryce of Edinburgh and will form the nucleus of a Chemical Reference Library. I regard the possession of this latter as essential to the success of Chemical research and its growth should therefore be carefully fostered by liberal annual grants.

Indents.

7. I have indented on the India Office for two years' stores and items of the first indent are now beginning to arrive at Lyallpur, so that by the time the laboratories are fit for occupation I expect to be in possession of sufficient material with which to commence Chemical work.

APPENDIX IV.

STATEMENT OF EXPENDITURE OF THE DEPARTMENT OF AGRICULTURE (INCLUDING THE CIVIL VETERINARY DEPARTMENT) FOR 1904-05 AND SUBSEQUENT YEARS SHOWING THE AMOUNT DEBITABLE TO THE SPECIAL GRANT MADE IN 1905 FOR THE DEVELOPMENT OF THE DEPARTMENT.

1	2	3	4	5	6	7	8	9	10	11
Head of Expenditure.	Expenditure during 1904-05 (taken as basis).	Expenditure during succeeding years.				3 times the expenditure in 1904-05 (the average before the special grant).	Expenditure in excess of average (to be met out of the special grant) (column 6 less column 7.)	Deductions.		Net amount chargeable to the grant (column 8 less columns 9 and 10.)
		1905-06.	1906-07.	1907-08.	Total.			Enhanced income. See column 8 of next statement.	Special Imperial assignments.	
AGRICULTURAL BRANCH.										
Office of the Director of Agriculture.	(a) 22,530	(a) 25,837	39,072	40,598	105,507	67,590	37,917	...	...	37,917
Itinerating Establishment & Agricultural Experiments.	2,161	11,892	7,727	9,671	29,290	6,483	22,807	2,567	...	20,240
Deputy Director of Agriculture.	...	7,363	12,760	14,957	35,080	...	35,080	705	...	(b) 34,375
Principal, Punjab Agricultural College.	...	...	7,970	13,928	21,898	...	21,898	...	...	21,898
Agricultural Chemist ...	...	...	2,272	10,131	12,403	...	12,403	...	...	12,403
Economic Botanist ..	...	...	...	2,917	2,917	...	2,917	...	..	2,917
Agricultural Station, Lyallpur.	5,916	6,243	7,689	9,929	23,861	17,748	6,113	4,020	...	2,093
Sargodha seed farm ...	(c) ...	2,964	3,777	7,047	13,788	...	13,788	15,290	...	—1,502
P. W. D. (original works) ...	...	19,796	190,554	162,145	372,495	...	372,495	1,445	...	371,050
" (Repairs) ...	99	256	308	2,016	2,580	297	2,283	...	...	2,283
Total Agriculture ...	30,706	74,351	272,129	273,339	619,819	92,118	527,701	24,027	...	503,674
CIVIL VETERINARY BRANCH.										
Punjab Veterinary College ...	30,269	34,640	48,109	37,649	120,398	90,807	29,591	14,805	...	14,786
Chief Superintendent, C. V. D.	53,452	69,918	79,016	103,403	252,337	106,356	91,981	...	...	91,981
Superintendent, C. V. D., South Punjab.	(d) ...	...	1,441	7,294	8,735	...	8,735	...	...	8,735
Do., North Punjab ...	...	...	2,905	8,077	10,982	...	10,982	...	(e) 5,491	5,491
Simla Veterinary Hospital ...	(f) ...	...	...	...	...	...	...	2,913	...	—2,913
Purchase of Stallions ...	...	33,670	5,388	2,556	41,614	...	41,614	...	(g) 18,300	23,314
P. W. D. (original works) ...	1,000	51,988	56,580	510	109,078	3,000	106,078	...	(k) 49,800	56,278
Do. (Repairs) ...	(h) 1,887	2,210	3,290	2,813	8,313	5,661	2,652	...	...	2,652
Total C. V. Department ...	86,608	192,426	196,729	162,302	551,457	259,824	291,633	17,718	73,591	200,324
GRAND TOTAL ...	117,314	266,777	468,858	435,641	1,171,276	351,942	819,334	41,745	73,591	703,998

(a) Represents half the cost of the combined office of the Director of Land Records and Agriculture, Punjab.

(b) The appointment of the Deputy Director of Agriculture was sanctioned before the grant was made. The expenditure on the Deputy Director and his staff might therefore be regarded as not debitable to the grant. But as the Local Government has contributed 1½ lakh per annum, I think it is fair to place these items on the debit side.

(c) There was actually an expenditure of Rs. 5,000 on the Sargodha Seed Farm in 1904-05, but it was largely initial expenditure. I have taken the expenditure in 1904-05 as *nil*, so that the position in this account is that all expenditure is debited to the grant and all income is shown on the credit side without deduction of any kind. This seems to be the most equitable adjustment.

(d) There was an increase in the subordinate staff in 1904-05 and following years on account of the scheme to add 42 Veterinary Assistants by annual additions, this scheme being sanctioned before the grant was made. But as in the case of the Deputy Director the incidental cost has been debited to the grant.

(e) Represents half the cost of the North Punjab office deducted as recoverable from the North-West Frontier Province (Government of India, Revenue and Agriculture Department, No. 826-53, dated 18th April 1906, to the Chief Secretary to Government, Punjab).

(f) Expenditure is included in the entries against the side-heads Chief Superintendent, and Public Works Department, up to 1906-07 inclusive when the Hospital was transferred to the Simla Municipal Committee on a contract.

(g) Half cost of stallions contributed by Imperial (Government of India, Revenue and Agriculture Department, No. 795-80-9, dated 2nd May 1905, to the Chief Secretary to Government, Punjab).

(h) Rs. 10,841 were spent in 1904-05 on original works, but this sum was abnormal and I have shown Rs. 1,000 as the normal annual expenditure on original works before 1905-06.

(k) Imperial contribution for the construction of buildings owing to the amalgamation, of the Ajmer Veterinary College (Government of India No. 16-84-6, dated 10th January 1905, to Chief Secretary to Government, Punjab) and the extension of the Dissecting room (Government of India, Revenue and Agriculture Department, No. 316, dated 13th February 1906, to Chief Secretary to Government, Punjab).

STATEMENT SHOWING THE INCOME OF THE DEPARTMENT OF AGRICULTURE FOR 1904-05 AND SUBSEQUENT YEARS.

1	2	3	4	5	6	7	8	9
Head of Income or Department.	Income during 1904-05.	INCOME DURING SUCCEEDING YEARS.				3 times the income for 1904-05.	Increase in income for the 3 years owing to the expansion of the department. (Column 6 less column 7).	REMARKS.
		1905-06.	1906-07.	1907-08.	Total.			
Lyallpur Agricultural Station ...	1,228	1,331	1,948	4,425	7,704	3,684	4,020	
Sargodha Seed Farm	...	886	7,023	7,381	15,290	...	15,290	
Sale of Seed (Agricultural Experiments.)	811	1,512	1,526	1,962	5,000	2,433	2,567	
P. W. D. (House rent) ...	...	...	...	1,445	1,445	...	1,445	
Deputy Director of Agriculture (American cotton).	...	...	...	705	705	...	705	
Punjab Veterinary College ...	5,831	8,129	10,350	13,719	32,298	17,493	14,805	
Simla Veterinary Hospital ...	351	1,667	2,299	*...	3,966	1,053	2,913	* Credited by the Simla Municipal Committee to which the Hospital has been transferred on a contract, in the accounts for 1908-09.

P96r
1908/09

REPORT

ON THE

OPERATIONS OF THE DEPARTMENT

OF

AGRICULTURE,

PUNJAB,

For the year ending the 30th June 1909.

Published by Authority.

Price : Annas 2-6 or 3d.

Lahore:
PRINTED AT THE "CIVIL AND MILITARY GAZETTE" PRESS
BY SAMUEL T. WESTON.
(Sole Contractors for Printing to the Punjab Government.)
1909.

OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, PUNJAB, FOR 1908-09.

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REPORT

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PUNJAB,

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1909.

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Proceedings of His Honour the Lieutenant-Governor of the Punjab in the Department of Revenue and Agriculture (Agriculture),—No. 202, dated the 2nd November 1909.

READ—

Letter No. 442, dated the 6th October 1909, from the Junior Secretary to the Financial Commissioner, Punjab, forwarding with the comments of the Financial Commissioner the annual report on the Department of Agriculture in the Punjab for the year ending 30th June 1909.

REMARKS.—The Agricultural Department in the Punjab is already beginning to make its influence felt, especially in the canal colonies, which contain the most progressive element in the rural population and in which the only existing agricultural station and seed farm are situated. The question of establishing a second station in the Punjab is still under consideration. So far the activities of the department have mainly consisted in preparation for the opening of the Agricultural College, in experiments with new and improved varieties of crops, and in the introduction of agricultural machinery.

2. Owing to the incomplete state of the buildings, the College could not be opened in the year under review. Its foundation has created considerable interest, and 574 applications for admission have already been received. Of these it is satisfactory to note that a fair proportion has come from landowners and others whose main object is to acquire a scientific knowledge of agriculture. For the first year, however, the number of admissions will be restricted to 16, as the teaching staff has not yet been fully recruited and trained in its duties. This is of course a ridiculously small number of students considering the excellent buildings that have been provided. It is hoped that it will speedily be possible to bring the numbers nearer to their full strength. The Lieutenant-Governor has elsewhere recorded his acknowledgment of the public spirit of Rai Sahib Mohan Lal in founding the Sir Denzil Ibbetson Scholarship and of Chaudhri Sultan Ahmad, Extra Assistant Commissioner, who has endowed a silver medal to be named after Sir James Wilson, Financial Commissioner of the Province.

3. The more interesting experiments have already been noticed by the officiating Financial Commissioner. Probably the most important results obtained are those concerning the milling and baking qualities of Punjab wheats. These show that the red wheats which are most suited for cultivation in the Province are superior from the point of view of both miller and baker to the soft white wheats which have hitherto been in greatest demand for export. The matter is one of great importance to the Punjabi cultivator and to consumers generally, and the Lieutenant-Governor cordially approves of the proposal to disseminate the information gained as widely as possible in the shape of a bulletin.

The result of the inquiries of the imperial committee on elevators is awaited, as the subject is one of the greatest importance to the colonies areas where the conditions are similar to those in Canada and the United States.

4. Another experiment of considerable interest is the attempt to revive sericulture in the Punjab. This attempt has attained a very fair measure of success. His Honour will follow with interest the results of Shaikh Ghulam Sadik's enterprise in taking over the operations in Gurdaspur and Kangra as a private venture. If he succeeds in growing and reeling good silk, the revival of a moribund industry should be assured. Considerable advance has been made in the work of selecting a cotton properly suited to the Province; interesting experiments have been made in the cultivation of jute, the trial of chrome leather for well buckets, the use of castor cake for manure and in sugar-making with Mr. Hadi's plant, but definite results in these matters have not yet been attained, though it would seem fairly clear that the Hadi process is not suited to the Punjab. Bee keeping and poultry farming have also received a considerable share of attention during the year. Arrangements are being made for leasing a large plot of land near Lahore to a military pensioner for use as a poultry farm, and the success of this experiment will be watched with interest. It is also hoped that it may be practicable to experiment with poultry by utilising the staff of the Lahore Zoological Gardens.

It is unfortunate that the state of the laboratories has delayed the investigation of the important *reh* problem. It should be taken up again as soon as possible.

Sir Louis Dane attaches great importance to the quinquennial wage census, figures which have recently come to notice showing that the data which are relied on for ascertaining rates of wages are often far from accurate.

5. Agricultural machinery is growing in popularity, as is proved by the fact that a commercial firm have considered it worth their while to relieve the department of the work of distribution in the case of reapers and some other implements. Much of the success attending the introduction of these machines is due to the zealous work of the Deputy Director, Mr. Milligan, who is at the same time fully alive to the danger of destroying the confidence already gained by trying to push things too fast. A promising feature in the year's work is the interest taken by visitors in the agricultural station, and the Lieutenant-Governor is pleased to note that the officers in charge are careful to show off the capabilities of the station to the best possible advantage.

6. The Agricultural Department, though still in its infancy, and handicapped by want of buildings and staff, has already justified its existence by real practical work, for which Mr. Renouf and his expert colleagues deserve much credit.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Junior Secretary to the Financial Commissioner for information, that they be published in the *Punjab Gazette* and submitted to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor,

H. P. TOLLINTON,

Offg. Secretary to Government, Punjab.

Punjab Government Press, Lahore—3-11-09—1412—591—K. C. M.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB.

FOR THE YEAR ENDING JUNE 30TH, 1909.

Part I.—Administrative.

Personal.

1. I held charge of the Department throughout the year.

Tours.

2. I spent 72 days on tour, visiting the districts of Amritsar, Shahpur, Kangra, Lahore, Rawalpindi, Jullundur, Gurdaspur, Ferozepore, Jhang, Multan, Muzaffargarh and Dera Ghazi Khan. I also attended the meeting of the Board of Agriculture at Nagpur.

The Deputy Director. See Appendix V.

3. Mr. Milligan's headquarters continue at Lyallpur. But it is hoped that it will be possible to provide a house for him at Jullundur by the autumn of 1910, when the opportunity will be taken of forming two Provincial Circles. Mr. Milligan was placed on special duty in England while he was on privilege leave last summer with reference to the construction of special reaping and winnowing machines for Punjab conditions and the experience of his machines has amply justified the step. Mr. Milligan has done excellent work in the introduction of improved agricultural machinery and he has had a busy year. Mr. Milligan officiated as Principal of the Agricultural College while Mr. Barnes was on 12 weeks' leave.

The Agricultural Chemist and Principal, Punjab Agricultural College. See Appendices IV and VI.

4. Mr. Barnes has again been hampered by want of laboratory accommodation and difficulties of staff. His laboratories will be ready by September and he will shortly represent the staff question. He took his work to Pusa in September, 1908, where he also acted on a special committee on indigo. The old Pusa laboratories were very kindly made available for his work. Returning to Lyallpur at the end of December, the duties of Principal made heavy demands on his time. He proceeded on privilege leave on the afternoon of the 13th April and on his return had unfortunately to apply for leave on medical certificate for six weeks. I have pleasure in acknowledging the thoroughness with which Mr. Barnes has gone into all the details of his work, and I hope that he will soon be in a position to start his laboratory.

The Professor of Agriculture. See Appendices I and II.

5. The appointment of Professor of Agriculture was held by Mr. Dobbs until September 3rd and then by Mr. Corbin until the end of the year. Mr. Corbin has been in charge of the Lyallpur Agricultural Station and he has also made special enquiries into opium. He has prepared a new scheme of cultural and manurial experiments for the Lyallpur Agricultural Station.

The Economic Botanist. See Appendices I and III.

6. The Economic Botanist has charge of plant breeding, plant selection and the trial of new varieties at the Lyallpur Agricultural Station. He also deals with fruit and has the control of the Mycological and Entomological Sections, in which, however, for want of staff, very little was possible. Mr. Milne has had very heavy work in organising his sections and in laying out his portion of the Lyallpur Agricultural Station. The inspection of his field plots furnished convincing evidence of the care and method with which his experiments are conducted.

Staff of the general branch.

7. There are three posts of Assistant Director. One officer appointed in 1908 at Pusa for a two years' course will pass out in 1910. This year, M. Fateh-ud-din, B.A., has been appointed to the second vacancy on Rs. 150-10-300, on 3 years' probation, and he also has been sent to Pusa for a 2 years' course. M. Fateh-ud-din belongs to a family of agriculturists. At the beginning of the year we had a farm manager and 7 agricultural assistants. The Manager of the Lyallpur Agricultural Station has obtained a good appointment on the staff of the Imperial Economic Botanist. One agricultural assistant resigned and another was promoted in the Department. On the other hand, four of the stipendiaries sent to the Cawnpore Agricultural College in 1906, who qualified for the Diploma of Licentiate in Agriculture in April, were given appointments as agricultural assistants. So, at the close of the year, we have an officiating manager and 8 agricultural assistants and these are all kept fully employed. We have 6 more stipendiaries at Cawnpore, 3 of whom will join the Department in 1910 and 3 in 1911. From 1912 onwards we shall obtain recruits from the Punjab Agricultural College. We were very shorthanded as regards Agricultural Assistants before the arrival of the new batch from Cawnpore and the staff deserve credit for their work. Difficulties as regards staff in the general branch should be less this year, and should gradually disappear. Our experience up to the present strongly confirms the view that men of true agricultural stock are needed for the various posts in the Agricultural Department.

College staff.

8. Two Assistant Professors out of five were recruited in 1907-08 and two men have been selected this year. These are Chowdhry Muhammad Zakka Ullah, B. SC., Lahore, Assistant Professor of Agricultural Chemistry, and Mr. Ram Gopal, M.A., M.R.A.C., Assistant Professor in Economic Botany. Mr. Carson, Assistant Professor of Entomology, and S. Kharak Singh, Assistant Professor of Agriculture, have joined their appointments after a year's training at Pusa. The remaining vacancy is in Mycology, and this will probably prove a difficult post to fill. Out of six Laboratory Assistants one was appointed last year, but resigned his appointment in April. M. Yusaf Ali, Agricultural, Assistant, has recently been promoted to Laboratory Assistant in Economic Botany. The Provincial Government was addressed during the year with a view to an improvement in the salaries of the Assistant Professors and Laboratory Assistants and the proposals as regards the Assistant Professors have been sent to the Secretary of State. I apprehend that we shall experience special difficulty in filling the posts of Laboratory Assistant in the Chemical Laboratory. As already stated, Mr. Barnes will shortly represent the case.

Clerical and menial staff of the College.

9. The clerical and menial staff required for the Agricultural College and Research Institute has now been sanctioned by Government, this including establishment for the workshop and for the boarding house.

The buildings of the Agricultural College.

10. Details of the drainage, gas, electric light, and workshop schemes were worked out during the year, and estimates have now been prepared and sanctioned for practically all that is needed except the workshop and dairy. It is expected that the work will be sufficiently advanced to permit of students being received on September 1st, although some further time will elapse before the buildings are finally handed over.

Subsidiary buildings.

11. Various additions needed to complete two of the staff bungalows are being carried out. Quarters are being built for various assistants whose constant presence is needed at the Agricultural Station. Poultry runs are being constructed. Plans and estimates for field stores and offices for the Economic Botanist have also received administrative sanction. The year has been a very busy one in the preparation of plans for subsidiary buildings.

Equipment of the College.

12. The initial equipment has practically all been received. Progress has also been made towards the formation of a library.

The opening of the College.

13. On Government sanction being received to the College syllabus, and the scheme for scholarships and fees, it was arranged that the first year's class should assemble on July 20th. Unfortunately it was found impossible to have the laboratories and lecture rooms ready by that date, and the start had to be deferred until September 1st. As the staff of assistants has not been fully recruited and has to be trained in its duties, only a very small class of 16 is being admitted this year. There were 135 candidates for the open scholarships and 574 applicants for admission. The large majority were probably under the mistaken impression that the Licentiates of the College will receive special consideration in the matter of Government appointments. But, apart from this, it was gratifying to see that there were a sufficient number of young men whose main object was to study agricultural science for its own sake, with a view to the practical application of their knowledge in the management of their estates. As indicated by Mr. Barnes, some slight amendments will be required in the Prospectus.

Scholarships and prizes.

14. Ten open scholarships, two in each division, each of the value of Rs. 10 per mensem, have been provided by the Local Government. Acknowledgments are due to Rai Sahib Mohan Lal for founding a scholarship of Rs. 12 per mensem in memory of the late Sir Denzil Ibbetson, and to Chowdhry Sultan Ahmed, Extra Assistant Commissioner, for endowing a silver medal to be named the "Sir James Wilson" medal.

Revision of Departmental Orders.

15. Orders of permanent and general interest which have issued during the year have been incorporated in the Departmental Orders, which have been revised and reprinted.

Bulletin on improved agricultural implements.

16. A bulletin has been issued on the subject of those improved agricultural implements which have been tested by the Department and which are likely to prove useful to cultivators. Information is given as to the price, source of supply, the special advantages of each implement, and the conditions under which it will prove remunerative.

Other work of the Director.

17. The periodical quinquennial cattle census was carried out in February, and the results have been reviewed in the Season and Crop Report. A scheme for a quinquennial wage census has been worked out. The first enquiry is to be made in December, provided the Province is free from plague and famine. The usual reports have been issued including the Season and Crop Report, the Veterinary Department Report, the Report on the Agri-Horticultural Gardens, the Kharif Note, Imperial Agricultural Statistics, periodical statistics of prices and rainfall, crop forecasts and weather and crop progress reports. Monthly notes on agricultural subjects have also been sent to the Press.

Inspections.

18. His Honour the Lieutenant-Governor made two visits to the headquarters of the Department at Lyallpur and saw all the work in progress at the Agricultural Station. Inspections were also made by Sir James Wilson, Mr. Merk and the Inspector-General of Agriculture.

Part. II—Agricultural Stations and Seed Farms.

Prefatory Note.

19. In the remaining sections of this report I propose to avoid as much as possible going over ground already fully covered in the reports of specialists which are attached as Appendices. In these cases, I shall confine myself to a very brief review.

The Lyallpur Agricultural Station. The Professor of Agriculture's section. See Appendix I.

20. The Economic Botanist having taken over the majority of the experiments in hand with new varieties of crops, the Professor of Agriculture has practically made a fresh start with a series of cultural and manurial experiments. As these experiments have just been started, there is very little to report. The work on machinery has attracted most attention. The steady increase in the number of visitors is undoubted and is most satisfactory. The rates for monthly

labourers were fixed after enquiry from the Deputy Commissioner as to the prevailing local rates. It is desirable to give them a trial after the College buildings are complete, as the construction of these has certainly disturbed the labour market.

As above. Section under the Economic Botanist. See Appendix I.

21. The comprehensive scope of the work on wheat and cottons can only be gathered from a perusal of the Lyallpur Agricultural Station Report. For reasons of space, the summary in Appendix I can only give an inadequate idea of the extent and the complexity of the experiments on these crops which have claimed the greater part of Mr. Milne's time. As regards cotton, it is satisfactory to notice that three varieties are to be tried on a larger scale. In a few years, we may, I hope, look for a large number of improved varieties of both wheat and cotton. The classification of Punjab cottons is in progress. Further enquiry is needed into jute before it can be recommended for general cultivation. The chief difficulties are in connection with retting and with stripping and cleaning the fibre. A fruit orchard and a botanical garden have been partly laid out, and will be stocked this year.

The Jullundur Agricultural Station.

22. The Collector of Jullundur gave his award for the land needed for the Jullundur Agricultural Station in May. Rough plans and estimates for the buildings and wells, for the Deputy Director's house, and for an office are now before Government.

The Sargodha Seed Farm in 1908-09.

23. Owing to calamities of season, the Sargodha seed Farm started the year with no good seed in stock and, indeed, had to obtain its own seed from outside. This spring, 123 maunds of American cotton seed were sold to cultivators, 78½ maunds being farm grown. There are now good stocks of Australian, Lyallpur and Baggi of Leiah wheat. No reapers have been sold. It is reported that a good supply of labour seems assured to the Jhelum Colony in ordinary years as numbers of people regularly come over for the harvesting from the Thal where the crops ripen later than in the Colony. The receipts amounted to Rs. 7,800-12-0 against an expenditure of Rs. 3,865-1-0, leaving a profit of Rs. 3,935-11-0. The Seed Farm is exempt from land revenue and cesses. The sum which would have been leviable under these heads would have been Rs. 643-12-0. The Farm and the accounts were inspected once by me during the year.

Part III.—Demonstrations and other operations connected with Agricultural Improvements.

(*a*). New and Improved Varieties of Crops, etc.

Operations with American cotton. Section II of Appendix V.

24. The Deputy Director shows that the growers of American cotton in the Jhelum Colony did well as regards outturn and price in 1908. The heavy rainfall seemed to suit this variety. I entirely agree with Mr. Milligan as regards the very serious difficulties which are encountered in creating a local market for American cotton. I understand that the same trouble is being experienced with Egyptian cotton in Sindh. There is a slight increase of cultivation this year, but it is impossible to expect a rapid expansion.

Distribution in districts of seed of selected indigenous cotton.

25. It was apparent in 1907-08 that the operations in 5 districts for the improvement of indigenous cotton by rough and ready methods through the agency of the district or settlement staff were not likely to meet with any success except perhaps in Hissar which was a special case. The experiment was restricted to the districts of Hissar, Lyallpur and Dera Ghazi Khan during 1908-09, and, with a view to ascertaining definitely if the crops grown from selected seed were in any way superior to the crops of ordinary good cultivators, field inspections were made by Mr. Milne in Hissar and by Mr. Corbin in the other two districts. Mr. Milne found that the selected Hissar seed had given distinctly better results than ordinary seed. The plants were very uniform in character and remarkably healthy. Mr. Corbin reported that he could discover no difference

between the cotton grown from selected seed and that grown in the surrounding fields. On receiving copies of Mr. Corbin's report, the Deputy Commissioners of Lyallpur and Dera Ghazi Khan both agreed that their experiments should be closed. The general impression is that cotton-growers in these districts already do all that is reasonably possible for non-scientific men in the matter of the selection of their seed. Brief details of last year's work are as follows. Mr. Townsend at Hissar was handicapped by the unfavourable season. Sowing his selected seed on about 2½ acreshe obtained 576 seers of uncleaned cotton per acre. This is less than last year, but much more than the ordinary outturn of the district which he estimates at 300 seers per acre. This year, the selected cotton is being sown in strips parallel with ordinary cotton so as to obtain a reliable comparison. Forty-nine maunds of selected seed were distributed in Lyallpur, and 98 maunds in Dera Ghazi Khan.

Other points in the Deputy Director's report. Appendix V.

26. Progress with the reh question (Section III) is still delayed pending the starting of the chemical laboratory. Further trials of chrome leather for well buckets are encouraging (Section VII). The distribution of castor cake as a manure may lead to useful results (Section VIII). As regards advice to Court of Wards estates (Section IX), it has been arranged that the Deputy Director will visit a few of the more important estates and see what suggestions can be made for their improvement. The Mamdot experiment will be followed with great interest. All Court of Wards estates have been invited to refer any difficulties which may present themselves.

(*b*). AGRICULTURAL MACHINERY.

General remarks.

27. The subject of the introduction of improved agricultural machinery has engaged a considerable portion of the time of the Deputy Director and the Professor of Agriculture. With the present scarcity of labour and high rates of wages in newly colonised tracts, as well as in many old districts, it is important that every endeavour should be made to provide or devise suitable labour saving appliances. Considerable success has already been obtained with the "Raja" reaper, the "Diamond" plough, bullock hoes, and chaff cutters.

Reaping machines. Section I of Appendix V.

28. It is sufficient for me to refer to Mr. Milligan's report on this subject. The new reaper has given great satisfaction, and it will do better still with the new cornside attachment. The arrangements for the practical instruction of cultivators in the use of the reapers left nothing to be desired. The classes were very largely attended.

Winnowing machines. Section V of Appendix V.

29. The trials with the winnower devised last year by Mr. Milligan encourage the expectation that we shall soon be able to meet the large demand for a reliable machine of this kind.

The "Diamond" plough.

30. The Diamond plough is referred to at length in the detailed report of the Lyallpur Agricultural Station. As 42 have been sold, it is obvious that it has made a good impression. Mr. Corbin remarks that it will turn a good furrow burying most of the stubble and weeds, and that it can be drawn by average-sized bullocks. He estimates that one ploughing with this implement is better than six or seven with a country plough, the cost per ploughing being the same. Land ploughed with the "Diamond" plough also retains more moisture.

The bullock hoe.

31. This implement is also described in the detailed farm report. Twenty-two have been sold. In future, it is intended to stock a more strongly-built British machine. It is useful as a grubber. Mr. Corbin reports that three to five acres can be tilled in one day and brought into cultivation similar to that ploughed with a *desi* plough. With a ridging attachment, two acres can be ridged in one day, at a cost of a rupee an acre against four rupees per acre for hand labour.

Other machines.

32. The accounts received of the steam thresher seem to show that it is not likely to pay in present Punjab conditions. Other machines under trial include a universal cultivator, and a hand hoe. The Ferozepore and Gujranwala well gears referred to in last year's report, have been improved by the inventors, and are being tried in the Agri-Horticultural Gardens at Lahore.

Arrangements for the sale of machinery.

33. The policy which has been adopted for the sale of improved implements, is to encourage private firms to take agencies for them. This saves us an infinity of trouble, and also places the matter on a thorough business footing. Messrs. Volkart Brothers took over the reaper this year and their arrangements for advertising and for helping purchasers with skilled mistris were excellent. This firm is now taking over some other implements, the success of which is practically established. For the first introduction of implements, an advance of Rs. 4,000 has been sanctioned by Government for the establishment of an Agricultural Machinery Depot. The working of the Depot is referred to in the report of the Professor of Agriculture (Appendix II).

Special staff for giving demonstrations of new machines.

34. A temporary staff of two muqaddams has been sanctioned for giving practical instruction in the handling of new machines. An Agricultural Assistant has been placed on this duty and two trained labourers and special bullocks are kept at the Lyallpur Agricultural Station for this purpose.

Concessions by the North-Western Railway on agricultural machinery and implements.

35. The North-Western Railway have kindly extended the concession granted last year for mowing and reaping machines in through booking with foreign lines from Karachi, to all other agricultural implements. They have also granted favourable rates to the Department for bullocks and machinery which are booked from Lyallpur for the purpose of demonstration at fairs.

The "Hadi" sugar-making plant.
See Section IV of Appendix V.

36. There is good reason to believe that the "Hadi" plant is not suited to the Punjab. It was very unfortunate that the special apparatus needed for the general enquiry into sugarcane was damaged in transit from England. Mr. Milligan will doubtless continue the enquiry this winter.

Well-boring.

37. Details of schemes for the organisation of a staff of well-borers and also for well-surveys in districts, in which well irrigation is of importance, have been submitted to Government. Recent successes in tapping improved supplies by deep borings make it probable that the services of well-borers will be in considerable demand. I am greatly indebted to the United Provinces Department for assistance in working out these schemes

Part IV.—Entomology.

General-work.
See Appendix III.

38. Owing to the resignation last autumn of the assistant on entomological work, very little has been possible this year in this section. Insect pests were also mainly conspicuous by their absence. The work of the Economic Botanist on silkworms, bollworms, and lucerne caterpillar is summarised in Appendix III.

Sericulture.
See also Appendix IV.

39. The sericulture experiment was confined to Gurdaspur, Chhanga Manga and Lyallpur. At the two last named places, the experiment was on a very small scale and was under Government supervision. At Gurdaspur, where Mr. Kennaway, Settlement Officer, was in charge, the silkworms were reared by private persons, at or near Nainikot in the Shakargarh tahsil, these being men who have been engaged in sericulture in a small way for years. The Kashmir Government very kindly lent us the services of three trained subordinates to give instruction in the methods in vogue in Kashmir. The produce was sent to Messrs. Anderson and Wright

to reel, and the silk has been consigned to Messrs. Durant Bevan and Co., London, for sale and valuation. The report of Messrs. Durant Bevan is still awaited, but the results as far as they have been ascertained are as follows :—

	OUNCES OF EGGS.		Weight of cocoons partly dried as despatched.	PRODUCE AS REPORTED BY MESSRS. ANDERSON AND WRIGHT.			
	Issued.	Hatched.		Dried cocoons.	Silk.	Chassum.	Silk per ounce of eggs hatched.
			M. S.	M. S.	S. C.	S. C.	S. C.
Gurdaspur ...	23	18½	7 7	4 1	31 13	15 3	1 14
Chhanga Manga	2	2	1 9½	0 29	7 2	1 15	3 9
Lyallpur ...	1	1	0 22½	0 15¼	3 2	1 1½	3 2

It will be noticed that, although it was thought that the cocoons were dry when they were despatched, such was not really the case. The additional loss in weight was least with the Lyallpur cocoons. The total percentage of loss in dryage of green cocoons has been 75 in the case of Chhanga Manga and 66 in the case of Lyallpur. The Gurdaspur cocoons arrived in a somewhat mildewed state owing to imperfect dryage. The report of Messrs. Anderson and Wright is as follows :—

"The Chhanga Manga silk have given the best produce. Also the quality and colour of the silk (pale yellow) seem superior to the other lots. Lyallpur comes next so far as produce is concerned, but the quality and colour of the silk (a bastard greenish yellow) do not appear equal to the other two. The produce from Gurdaspur is not as good as the others, due to a large extent to the cocoons being damaged. Otherwise the outturn would probably have been equal to the Lyallpur rearing. The quality and colour (pale yellow) are nearly as good as the Chhanga Manga silk. The cocoons are not as big as Kashmir cocoons, nor do they contain as much produce, but they are better shaped."

Besides being of better quality, the Chhanga Manga produce was the highest per ounce of seed hatched. The Gurdaspur rate is very much lower. There is always a suspicion that the Gurdaspur rearers may have kept back some of their cocoons. But the Chhanga Munga food supply was by far the most abundant and the easiest available, and the arrangements made at Chhanga Manga and Lyallpur were much superior to those of the Gurdaspur rearers in spite of repeated injunctions. The Gurdaspur rearers certainly did not give their worms enough leaf. They did not keep their silkworms warm enough in the early stages, and the space provided was generally very inadequate. When the valuations are received, it will be apparent how much has been lost by the Gurdaspur rearers by inattention to elementary points in the management of silkworms. Definite conclusions must be deferred until valuations are received. But it is satisfactory to find that Shaikh Ghulam Sadiq, Honorary Magistrate of Amritsar, who tried six ounces of seed at Sujanpur and who is reeling his own silk, was so favourably impressed by the results obtained with disease-free eggs, that he has taken over the operations in Gurdaspur and Kangra next year as a private enterprise, obtaining two hundred ounces of eggs from France through the Department. He proposes to reel all the silk himself, and he will also probably make an offer to the Forest Department for a further experiment at Chhanga Manga. The outturn of cocoons per ounce with disease-free eggs was far greater than with country eggs. The local methods of management in Gurdaspur are defective in many respects, and an endeavour will be made next year to demonstrate the advantages of better arrangements for rearing in Gurdaspur. I am greatly indebted to Mr. Kennaway for the close attention which he devoted to the Gurdaspur experiment. My thanks are also due to the Forest Department, to Mr. Milne, Economic Botanist, Punjab, and to the Kashmir Sericultural Department for their assistance.

Apiculture.

40. Thanks to the personal interest and lead of His Honour the Lieutenant-Governor, a very promising start has been made with bee-keeping in Simla on scientific and up-to-date principles. There is a good strain of bees in the Simla Hills, remarkable for their docility and for the quality of their honey, and bee-keeping with rough and ready methods is very general among natives and not uncommon among Europeans. Frame hives and modern appliances were first introduced by the Lieutenant-Governor at Barnes Court, and these were almost immediately taken up by a large number of European residents who have formed an association with Sir Louis Dane as patron. Mr. Carson, Assistant Professor of Entomology, was able to give very valuable help to the members of the Association in all the details of bee-keeping.

Part V.—Miscellaneous.

Pusa Bulletin XIV of 1908 on the milling and baking qualities of Indian wheats.

41. The facts brought forward in Pusa bulletin No. XIV of 1908 by Mr. and Mrs. Howard on the milling and baking qualities of Indian wheats are of extreme importance to the Punjab. They can, however, only be adverted to very briefly in this Report. Prior to the issue of this bulletin the prevailing impression was that Indian wheats were generally "weak" and that only the soft Indian white wheats which are weak wheats were suitable for export to England. By 'strength' is meant "the capacity for making large and well-shaped loaves," and the 'strength' of a flour is usually in proportion to its nitrogen content. The idea that the best Indian wheats are the soft white, which are weak wheats, was based on the report of Messrs. McDougal Brothers in 1882, and on the circumstance that white "Delhi" wheat was formerly shipped with a much lower percentage of barley and dirt admixture than white "Karachi." Another consideration which kept hard wheats out of the market was that the older milling processes were not capable of dealing with the harder Indian wheats. Accordingly, exporters have pursued the policy of stipulating for soft white wheats, or for a mixture consisting chiefly of "soft white," and have placed a premium on these qualities. In response, cultivators have grown white wheats specially for the market, although the climate and soil of the Punjab are better adapted to the stronger varieties which are generally hard red. Mr. and Mrs. Howard, after classifying the wheats of Northern India, had analyses made of the various varieties and sent samples of the principal kinds for milling and baking tests to Mr. Humphries, Chairman of the Committee of the Incorporated National Association of British and Irish Millers. The results of analysis and the report of Mr. Humphries show conclusively that some of our hard red varieties are much 'stronger' than the 'soft white' and are much superior to them from the English miller's point of view. The analyses cited in the bulletin establish that the stronger wheats contain 50 per cent. more nitrogen than the weaker white varieties. It has already been stated that the soft white wheats do not really suit the Province. It may be mentioned that the harder and stronger wheats are those which are preferred by cultivators for their own consumption, as they are found to be more sustaining. The grain, too, is much more resistant to weevil. It is obvious, then, that the Punjab cultivator and the trade are losing owing to the misconception as to the possibilities of wheat growing in the Punjab. I have addressed the Karachi Chamber of Commerce, the Incorporated National Association of British and Irish Millers and the Liverpool Corn Trade Association with a view to ascertaining why a premium is still offered for the apparently inferior wheat, and I have pointed out that a premium on what are really the strongest and best varieties or mixtures would result in a few years in the almost complete disappearance of soft white wheats. The matter is solely and entirely in the hands of the trade as the cultivator will grow whatever commands the best price. Thus far, replies have been received from the first two associations. The revolution in milling machinery now enables millers to deal with hard wheats as easily as soft wheats. The Karachi Chamber of Commerce consider that there is every reason to believe that many up-to-date millers now prefer the harder and stronger "Karachi" wheats and they are of the opinion that the harder and stronger wheats such as those recommended by Mr. Humphries are of the higher milling value. Both the Karachi Chamber

of Commerce and the Association of British and Irish Millers, however, state that white wheat is still preferred in some sections of the milling industry, although there is no doubt but that this preference for colour is only justified when other considerations are equal. The Karachi Chamber of Commerce consider that there is little doubt that the demand for stronger Indian wheats will make itself felt, although it is not to be expected that the demand for softer wheats will cease at once. The trade custom will certainly be slow in changing. But it is to be hoped that the exporters and English millers will co-operate in promoting what is as much to their interest as to that of the cultivators, for all concerned must gain in dealing with a more valuable product. In the meantime, all that can be done is to keep the matter before the public, and I propose to print the correspondence as a bulletin. It is impossible to say what sum is at stake. But the importance of the question can be judged from the circumstance that each additional anna per maund on an export of one million tons means £116,666. We shall have the strongest and the best of the local wheats isolated at Lyallpur, but they will never be taken up by the agricultural community unless they can be sold for more than the wheats which are now in demand.

Grain elevators.

42. The subject of grain elevators, particularly in connection with wheat, came up for consideration on the appointment of a special commission by the Railway Board to enquire into the matter. With the prospect of an addition, when the new canals are opened, of at least half a million tons to our average annual export of a million tons, the question is one that affects the Punjab very closely. Punjab wheat at present suffers from being exported with a substantial admixture of foreign grains and dust. An immediate result of the introduction of the elevator system would be that our wheat would be placed in the European markets in a much better condition, as elevators provide machinery for cleaning and for separating foreign grains. This would benefit the entire trade from the exporter to the grower. Other advantages would include the cheapening and facilitating of handling, safer storage against bad weather and thieves, possible greater protection against weevil and, to a certain extent, easier and more economical railway working. It seems doubtful if the rush of wheat to Karachi in June, July and August would be much reduced.

Enquiry into changes in the rainfall and underground water table.

43. An exhaustive enquiry has been made as to whether there is any permanent change apparent in the annual rainfall or in the underground water table. The rainfall question has been dealt with by Dr. Walker, Director-General of Observatories, and he finds that there is no proof of any climatic change. There has been a tendency over a large part of North-West India for rainfall—

(*a*) to increase to a maximum between 1892 and 1894,

(*b*) to sink to a minimum in 1899,

(*c*) to improve very slowly since that time.

Dr. Walker adduces good reasons for holding that any changes in North-West India must be attributed to something abnormal in the large movements of the atmosphere and not to local extensions of irrigation or to deforestation. The investigation of the water table was made through district officers. It is apparent that there has been a certain drop in the water level in the last 14 years of deficient rainfall. The average subsidence is from 2 to 3½ feet in the Jullundur district and this figure can probably be accepted for the Province as a whole in tracts unaffected by canals. An important inference which stands out is that the scanty Punjab rainfall in the plains does not affect the water level to any extent, and that the principal factor in the supply of subsoil water is the supply of water in rivers, streams and canals. If this view is correct, then the ultimate cause of change is rainfall in the hills, in the catchment areas of the Punjab rivers. The desideratum being a steady reliable and ample flow in the rivers in their course through the plains, the importance of forests in the catchment areas with their influence on the intensity of the rainfall in the hills and on the storage of water cannot be over-estimated.

Agricultural Associations.

44. The Lyallpur Agricultural Association held two well attended meetings, at one of which the Financial Commissioner, Sir James Wilson, was present. Useful discussions took place on subjects of local importance and visits were paid to the Agricultural Station where demonstrations of new implements and machines were given. The "Townsend" Agricultural Association in Hissar has continued to devote its attention mainly to the improvement of stock. About 100 inferior bulls were removed during the year and four camel stallions purchased by private subscription were at work. No applications were received for the formation of new associations during the year. It is hoped that the establishment of an Agricultural Station in Jullundur will be the signal for the organisation of an association in that district.

Shows of agricultural produce and implements. See Section X of Appendix V.

45. Four shows of agricultural produce were held this year, at Lyallpur, Ferozepore, Ambala and Karnal, the last named being held for the first time. All these shows were attended by the Deputy Director. New implements were exhibited working at Lyallpur, Jalalabad and Karnal. As we now have a compact collection of improved implements and machines, arrangements will be made to give demonstrations next winter at a certain number of selected cattle fairs in districts in which improved implements are most likely to be taken into use.

District Gardens.

46. The accounts for the year ending March 31st, 1909, of the four gardens noticed annually in this report are as follows :—

	Income.	Expenditure.
	Rs.	Rs.
Shahdara	1,082	8,256
Shalimar	3,477	4,816
Kudsia	1,267	1,850
Roshanara	4,166	2,500

The Mahasu orchards.

47. The arrangements for the management of the Mahasu orchards and the issue of young fruit trees for fruit-culture in the hills remain unchanged. Applications were received for 8,232 fruit trees and 3,253 were actually supplied.

W. RENOUF, C. S.,

Director of Agriculture, Punjab.

APPENDIX I.

REPORT ON THE ADMINISTRATION OF THE LYALLPUR AGRICULTURAL STATION FOR 1908-09.

SECTION UNDER THE PROFESSOR OF AGRICULTURE.

1. During the year under report, the botanical and the agricultural work have been separated. This necessitated the modification of experiments already in existence and the commencement of new experiments. The Farm area of 450 acres is now utilized as follows:—

	Acres.
Experiments controlled by the Professor of Agriculture	110
Experiments controlled by the Economic Botanist	70
Farmed by tenants	270

2. Schemes have been made with a view to the improvement of Punjab poultry and it is expected that the poultry houses will shortly be erected by the Public Works Department.

3. A scheme for a dairy has been worked out and is under consideration, the idea being to have a model dairy which will supply the agricultural suburb of Lyallpur.

4. The experimental work which is being conducted on the Farm is set out in a permanent cropping scheme, which has been approved after discussion by the other professional members of this Department. This scheme will lend continuity to the experimental work.

5. The land set apart for experiment has been suitably divided up into areas each of about one acre in extent, in some cases 2 acres. Comparative cultivation and manurial experiments are being carried out on these areas which are oblong plots and arranged alternately alongside each other. The plots have been made as large as possible so as to give reliable results. The chief experiments are for testing:—

(*a*) Various methods of cultivation.
(*b*) Use of new machinery.
(*c*) Green manures.
(*d*) Fertilizers.
(*e*) Water requirements of staple crops.

6. During the year, interest in the Farm has markedly increased among the landowners and cultivators. The number of visitors has steadily increased and the machinery used on the Farm has become popular among many of those people who have purchased implements.

7. The expenditure for the year ending March 1909 was Rs. 11,111-12-6 and the income Rs. 6,315-0-10 as against Rs. 9,195-2-3 and Rs. 4,424-11-6 for the year 1907-08.

The increase in expenditure was due to the extra labour employed in laying out experimental plots and levelling which is so essential on irrigated land, also to the increased rate of wages in the neighbourhood and expenditure on implements and machinery. The increased income is due to the slightly greater area of the Farm and enhanced yields and prices.

8. An attempt has been made to replace temporary labour engaged on the farm by permanent monthly paid labour, but the rates as sanctioned at present are not sufficient to attract and retain the right class of labourers.

H. H. CORBIN,
Professor of Agriculture, Punjab, Lyallpur.

SECTION UNDER THE ECONOMIC BOTANIST.

Experimental area. 1. The experimental work has been greatly hampered for want of suitable lands, stores and a sufficient number of agricultural and other assistants. About 70 acres of land formerly attached to the Lyallpur Experimental Farm under the Professor of Agriculture has now, however, been put under my charge for experimental purposes. About 30 acres of this is being laid out for growing cottons and wheats. A few acres of it are being prepared for fruit experiments, and more will be set aside for this purpose when necessary. The remainder of the land will be used for growing the various other crops which will have to be dealt with.

Field stores. 2. Necessary field stores and fittings have been designed for the section.

Water inlets. 3. Pucca water inlets have been designed to prevent as far as possible stray seeds getting into the experimental plots and to avoid the havoc wrought to plots by labourers closing up the present katcha inlets.

Agricultural Assistants.

4. The number of Agricultural Assistants which I have had have been quite insufficient to enable me to deal properly with the work in hand. The men, however, have done their very best to assist me both in and out of working hours, and we have been able to keep things going and do something towards the organisation of the work.

Cottons.

5. About 1,000 varieties and selections of cottons have been dealt with. These have been systematically arranged and systems of recording the characteristics of the plants and of judging the merits of selections have been introduced. About two-third of the above number of cottons have been discarded this year after examination. Two types of American cottons and one desi variety which gave promising results have been handed over to the Professor of Agriculture to be tested on a large scale before being sent out to the zamindars. Tree cottons and African cottons have proved of no use here and the Egyptian cottons have done very poorly. A survey of the cottons of the Punjab has been started.

Wheats.

6. About 7½ acres of land were occupied by the experimental wheats. The cultivations and waterings were those given by the ordinary zamindars of the district. A standard variety (Daudkhani of Delhi) was sown at intervals to check the evenness of the quality of the land. A system of recording notes similar to that used in the case of cottons has been introduced.

Australian wheats.

7. About 20 varieties of Australian wheat were grown. As a rule they were not as good yielders as the indigenous wheats.

Indigenous wheats.

8. About 200 selections of indigenous wheats were grown separately. Of these the beardless common wheats with red glumes gave the best outturns and lodged less than others.

Classified Punjab wheats.

9. The 25 types of wheats classified by the Imperial Economic Botanist were grown on as large areas as we had seed for. A proportion of the seed of the best of these varieties will be handed over to the Farm to be further tested before being distributed to zamindars.

Jute.

10. The crop was badly damaged by the jute semilooper caterpillar (Cosmophila sabulifera). Four plots were sown at different dates from 10th April to 5th July. They all ripened in the end of September. The crop requires water about once in every two weeks. In the retting experiments, as good results were got from the ordinary zamindari pit as from the cemented tanks. A batch of jute put into a tank about 1st October requires about 1 month to ret. Even the damaged crop of this year produced fibre which will find a ready sale in Calcutta and probably would do so to a limited extent locally also. Further work is being done on jute.

Other crops.

11. Barley, oats, gram, cassavas, etc., were also grown.

D. MILNE,

Economic Botanist, Punjab.

APPENDIX II.

ANNUAL REPORT OF PROFESSOR OF AGRICULTURE, PUNJAB, FOR THE YEAR 1908-1909.

1. My work in the Punjab commenced on September 3rd, 1908. I took up the duties of Professor of Agriculture and also officiated as Deputy Director of Agriculture, Punjab.

(i). An office has been organised under my control and deals with the ordinary business in connection with the agricultural work of the college besides matters relating to work outside in the district. This office does the accounts and correspondence in connection with the Machinery Depôt.

Work done during the year.

2. For short periods of time an Agricultural Assistant has been lent to the Agricultural Section of the College and has occupied himself in collecting specimens for use in lectures and demonstrations and he has made investigations into the conditions of land and crop outside the Farm.

3. Much of my time during the cooler months has been occupied in trials of implements and devising new machinery to suit the Agricultural conditions prevailing here.

4. New methods of sowing and after cultivation have been experimented with on the Farm crops. It would be quite profitable for a man with a little capital to sow his crop in lines and buy machines for inter-cultivation. Further details are given in the report on the Farm.

5. Many visitors interested in improvement in agriculture have come to the Farm for advice and to see the implements and machinery recommended by the Department. I have personally conducted many of these visitors round the Farm and shown them he various points of interest.

6. During the year under report the administration of the Farm has been under my control and experiments of such a nature as to require several years before definite results will be obtainable from them, have been put on record in a permanent cropping scheme.

7. The improvement of poultry in the Punjab has been taken in hand and a few breeds of fowls have been obtained to experiment with, but progress cannot be made until proper pens are constructed. It is hoped that these poultry pens will be ready soon.

8. A scheme for a dairy has been elaborated, the idea being to have a model dairy which will supply the agricultural suburb of Lyallpur.

9. Several demonstrations of the use of our improved methods, implements and machinery have been held in the Province with the result that a number of progressive land-owners and cultivators have purchased appliances from the depôt.

10. About ten acres of land has been set apart for the students of the college to cultivate with their own hands.

11. The Machinery Depôt has been organised and is now in running order. The policy of the depôt is to supply the demand for agricultural appliances until there is sufficient business to make it worth the while of a commercial firm to step in and carrying on the work of an agent. A certain number of machines as detailed below have been ordered from Europe and America and have been sold in the Punjab.

Name of appliances.	Number sold.	Cost of each. Rs.	a.	p.
(1). Winnowing machines to separate bhusa and grain	20	150	0	0
(2). Ploughs (Canadian make)	42	26	8	0
(3). Chaff cutters (English make)...	88	44	0	0
(4). Bullock hoes (American make)	22	39	9	0
(5). Large cultivators (American make)	2	200	0	0
(6). Hand hoes of planet junior pattern (American make) ...	4	35	8	0

Any purchaser, before taking delivery of any appliance, is invited to come to the Farm and see his appliance working and to learn how best to adjust, &c. Many purchasers either come themselves or send their men to be trained. The demand for reapers and ploughs seems to be steadily increasing, and if more outside demonstration be quietly given on land which is lent by any zamindar for the purpose, I think that there is likely to be a much greater demand. Large demonstrations do not seem to be so successful as small exhibitions of really good work on the land of a purchaser.

12. Since joining my appointment I have toured in the various parts of the Punjab on inspection duty and have seen the general conditions prevailing amongst agriculturists of the Punjab. I inspected many fields of cotton which had been grown from seed previously selected and I reported on this subject to the Director. I made an extensive tour collecting information concerning poppy cultivation in the Punjab and took Botanical specimens of the various poppies under cultivation and wrote a report on this and the extraction and preparation of Punjab grown opium. In addition to the above much of my attention has been taken up in routine office work and accounts.

Tours.

H. H. CORBIN,

Professor of Agriculture, Punjab, Lyallpur.

APPENDIX III.

REPORT ON THE PROVINCIAL WORK OF THE ECONOMIC BOTANIST, PUNJAB, FOR 1908-09.

BOTANICAL SECTION.

1. Some 3,900 miles were travelled by rail and 40 miles by road. This includes tours to the Hissar and Sargodha districts to inspect the cottons growing there and also tours in connection with the introduction of cassavas. A great deal of the touring was also done in connection with the College fittings, selection of staff and acquiring information regarding the proposed teaching collection of plants and fruits experiments.

Tours.

Cassavas.

2. Experimental plots of cassavas from various parts of the world have been put down at Rewari, Ambala, Gurdaspur as well as at Lyallpur, to discover whether the plant can be successfully grown in the Province. Some information will be to hand by December 1909.

Colocynths.

3. With a view to discovering whether zemindars in districts where colocynths grow wild could add a little to their income from these, enquiries were made at Karachi, Calcutta and London as to prices and the state of the general market. The information received is that all these places are already over-supplied.

Withania coagulans (panir).

4. Fruits of Withania Coagulans have been enquired after, for commercial purposes, by a German Firm in London. Samples have been supplied to them.

Miscellaneous.

5. Various other plants have been collected and supplied by request to firms in India and abroad. Advice and assistance as far as possible has also been given on request to various people.

Entomological Section.

Silkworm rearing experiment.

6. One ounce of silkworms' eggs were obtained from France, through the Director of Sericulture, Kashmir. Hatching commenced on 3rd and continued till 8th March. Practically all the eggs hatched out. The latest of the worms completed seripositing by the 26th April. A heat wave about the middle of April had a somewhat deleterious effect on the worms. To avoid the risk of such happenings here, it is important to obtain varieties of mulberry that will come into leaf as early in the spring as possible. The outturn of green cocoons was 48¼ seers which yielded 25⅛ seers dry cocoons. The cocoons have been sent to be reeled at a filature in Eastern Bengal, and up to date no further information regarding them is to hand. The results, I think, are very satisfactory for a climate like Lyallpur.

Cotton bollworm.

7. On the Lyallpur Agricultural Station, the damaged bolls in the cotton fields in July, 1908, were about 2 per cent., in August, 1·14 per cent. and in October, 16 per cent. while the number of worms in the damaged bolls ranged from 1 per cent. to 3·7 per cent. The cotton fields in several places in the Multan, Montgomery and Lyallpur districts were also examined. They showed little or no damage.

Lucerne caterpillars.

8. Experiments showed that if the land was flooded while the crop was tall, a great many of the caterpillars would escape from the water by climbing up the plants. It also showed, however, that flooding the land would be very effective if the crop was cut before the water was applied, or if it was short enough to be completely covered by the water.

Other insect attacks.

9. Other insect attacks dealt with were jute caterpillar (cosmophila sabulifera) on jute, stem borer (chilo simplex) on jowar and sugar-cane, earcockle (tylenchus tritica) on wheat, green fly and painted bug (bagrada picta) on cruciferous crops, &c., &c.

D. MILNE,
Economic Botanist, Punjab.

APPENDIX IV.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST, PUNJAB, FOR THE YEAR 1908-09.

Prefatory.

1. In reviewing the work of the Agricultural Chemist for the year ending July 31st, 1909, I have to again point out that this work has been seriously hampered by the want of proper laboratory accommodation and staff. The former difficulty will, I think, soon be a thing of the past for I hope to be in a position to start in the research laboratory towards the end of September, if the gas, water and drainage systems are in working order by the 10th of that month. But the latter cause of delay is a much more serious difficulty since it has been found impossible to obtain assistants possessing the requisite educational qualification on the present sanctioned scale of pay. I am making this the subject of a separate note.

Chemical work.

2. Two subjects only of chemical importance have been taken up during the year. One is the systematic examination of the alkali soils of Northern India and the other is the analysis of sugar in connection with the testing of the Hadi plant at Lyallpur. The chemical examination of the alkali soils was commenced at Pusa last autumn but had to be suspended on my return to Lyallpur, and since then I have not had the opportunity of resuming this work. As by far the greater part of these analyses still remain to be carried out before the investigation can be completed, and in view of the importance of the subject, it is advisable for me to be provided with the requisite staff to carry on this work to the stage of completion at as early a date as possible. After my return to Lyallpur the available resources of the laboratory were utilised in carrying out the chemical work connected with the testing of the Hadi sugar-making process. This work is not yet complete, but there seems every indication that the process is not one which we can recommend for use in the Punjab.

3. Temporary accommodation was provided for me in the Chemistry Block during the months of February, March and April but these quarters had to be again handed over to the Public Works Department in May for the purpose of laying down water piping and drainage. The laboratories will not be available for use until both these and the gas installation are complete, which, I understand, will be by the 1st of September.

The laboratories.

4. A systematic course of instruction in Chemistry and Physics has been under consideration and preparations made to commence the course as soon as the laboratories and lecture theatres are available. In connection with the course in Chemistry, I anticipate that for some years to come the lectures will have to be given entirely by the head of the chemical section for it is of the greatest importance that a thoroughly sound course should be laid down, the weak points discovered and eliminated, and the whole thoroughly systematised before the Assistant Professor takes up any of this work. A certain proportion of the lectures will always have to be given by the Professor but during the first few years I foresee that the whole of this work will fall on his shoulders. It will be necessary also for the Professor of Chemistry to deliver the lectures on Physics for at least the first year. I do not consider that one Assistant Professor is an adequate staff for the teaching of Chemistry and Physics, and I propose to bring this subject up again in a separate note.

College courses in Chemistry and Physics.

5. During the past year, by far the greater part of my time has been taken up with office work connected with the combined duties of Agricultural Chemist and Principal of the College. A large proportion of this work has had to do with the College buildings, fittings and the supplementary schemes in connection with the College. Even when these are finished the duties of the Principalship will add so materially to my work and will make such calls upon my time that my duties as Chemist will be seriously interfered with and it is with a view to the importance of the latter that I would advise the strengthening of the Chemical staff be given careful consideration during the forthcoming year.

Office.

J. H. BARNES,

Agricultural Chemist, Punjab.

APPENDIX V.

ANNUAL REPORT OF THE DEPUTY DIRECTOR OF AGRICULTURE, PUNJAB, FOR THE YEAR 1908-09.

1. As an annual report of this kind ought to be mainly of the nature of a progress report, I propose to follow the usual practice of noting briefly on the main undertakings of the section immediately under my charge. Where any new work has been undertaken, mention has been made of this.

I.—*Introduction of Reaping Machines.*

2. The progress of this undertaking has been the subject matter of a special note already submitted to Government.

3. Summarised briefly, it may be stated that the undertaking has this year been placed on a commercial footing by the firm of Volkart Brothers accepting an Agency for agricultural machinery, and that such marked improvements have been made in the pattern of machine in the way of increasing its efficiency and diminishing its draught as to bring it within the scope of the smaller zemindars of the Colonies. The business side of the concern was run this year by the firm in question with marked success and relieved the Department of a great deal of the financial trouble experienced last year.

4. The courses of instruction for *lohars* and *mistries* inaugurated last year and confined to lessons on the care and use of the machines were this year expanded into a more useful course by the production of actual harvesting conditions made possible by the sowing of an early barley crop for the purpose. These instructions proved very popular and fully justified themselves in the final results obtained in the Districts.

5. The following items of interest may be noted :—

(a).—Numbers sold.—The firm sold during the season 49 machines, of which four went to other provinces. The distribution owing to priority of indentry was not all that could be desired, only 25 being used in the Lyallpur district. Lyallpur zemindars will not book early. The result was that this year a good deal of disappointment was felt amongst people who came in at the last moment and found all the machines sold.

(b).—General results.—As in last year, the most satisfactory results were obtained in the Lyallpur district, where, without exception, the machines were successfully used.

(c).—Daily averages.—The real gauge of success may at once be measured by the average daily cuttings; last year's figures in Lyallpur district gave five killas per day, which was at the time considered satisfactory. This year's average in the same district shows a 30 per cent. increase, being 6·5 killas (7·2 acres).

(d).—*Labour employed.*—The average for this year works out at 1·75 per killa, the same figure as last year, but represents a marked improvement, as the crop was at least 30 per cent. heavier.

(e).—*Quality of the work.*—The average quality of the work shows a very marked advance on anything I have yet seen in the country, notwithstanding the heavy crops encountered. All the old complaints as to high cutting, loss of ears, etc., have disappeared, and users are quite satisfied that such drawbacks are due to careless handling on their own part.

(f).—*Profit and loss.*—It has been freely anknowledged all round that the profit has this year amounted to 100 per cent. on the outlay.

6 Summarizing, it may be stated that with the present arrangements for distribution and reasonable facilities given by the Department for instruction in their care and use, there is every prospect of the successful use of such machines over a large part of the Colonies. On the whole, it requires a fairly intelligent and persevering man to run a machine successfully, but it is quite apparent to all acquainted with the Lyallpur District that there is a very large proportion of zemindars with the necessary enterprize and ability.

II.—Acclimatised American Cotton.

7. As stated in last year's report, the area under this crop showed a marked decrease on the year 1907-08 doubtless mainly due to its comparative failure in 1907, the area in the Jhelum and Chenab Colonies being 445 and 142 killas respectively.

8. Last season, the swing of the pendulum proved in favour of the exotic for while the *desi* crop was on the whole poor, the American variety gave about a normal yield. This may be to a large extent accounted for by the character of the season, although a fresh importation of seed from Dharwar had doubtless a beneficial effect.

9. The usual assistance was given to growers in the way of advice as to cultivation, etc., and the arrangements for marketing were carried through by the Department. The distribution of seed was effected through the Colonization Officer, Sargodha.

10. A new way of disposal, *viz.*, by public sales was this year adopted, partly on account of complaints regarding our previous arrangements and partly to more correctly estimate the value of the American kapas in an open market.

11. Two public auctions were accordingly held on November 20th, 1908, and January 10th, 1909, when over 2,200 maunds of kapas were disposed of. The prices obtained were on the whole satisfactory, representing a premium of Rs. 1-5-3 and Rs. 1-9-0 p.m on the price of the *desi* article on the same days, but there was a disappointing lack of competition for the kapas, in spite of a great deal of canvassing and advertisement by the Department. The chief reasons for this are not far to seek. In the first place, the spinner is used to buying ginned cotton and not kapas and deals directly with the ginning factories in whose hands the whole of the selling trade lies. Secondly, the quantity offered for sale was really too small for the majority of spinners. Although this class of cotton meets a ready market in the Bombay Presidency, the market for it in the Punjab is limited, or, to be more accurate, is confined practically to one firm in Lahore. Further, the local ginning factories, which in the present state of the trade would naturally be the buyers of kapas, are averse to dealing with small quantities, which not only give them a lot of trouble to gin, but for which they are not quite certain of a ready market.

12. The marketing of the produce, therefore, will continue to give a good deal of trouble. There seems to me only one way out of the difficulty for the enterprise in the Jhelum Colony and that is a strong syndicate composed of growers, owners of ginning factories and spinners, formed with the object of growing acclimatized cotton.

13. This is not possible at present, as our breed of cotton requires very considerable improvement and adaptation to drought conditions before any real expansion in cultivation can take place. There ought to be, and I think there is, a considerable demand in India for this class of cotton if properly ginned and baled and put on the market in good condition. Personally, I am convinced that our department unaided will not prove equal to the task of putting this and similar ventures on a sound commercial basis and I put forward the suggestion as a possible means for the solution of a problem which is bound to become increasingly urgent.

14. It has been customary hitherto to give an estimate profit and loss statement of the crop viewed from the stand-point of the grower.

15. The following would approximately represent the profit on one killa for the year 1908, grown with American Cotton in the Jhelum Colony as compared with the ordinary *desi* crop :—

	Rs.	a.	p.
American cotton, 6 maunds at Rs. 7-6	44	4	0
Desi, 4 maunds at Rs. 6-0	24	0	0
Difference	20	4	0

which probably represents the best return yet obtained since the introduction of the crop. The profit per killa for the Chenab Colony would be about Rs. 10 per acre, the difference being due to a lower price obtained through inferiority of sample and to less difference in the yield between the two varieties.

16. *Sowings in* 1909.—The sowings for this year in both colonies show an increase of 487 killas, the figures being :—

	1908.	1909.
Jhelum Colony	445	631
Chenab Colony	142	423
Total	587	1,054

III.—Reh.

17. This question has, much to my regret, unfortunately had to be partially shelved owing to the non-completion of the Chemical laboratory at Lyallpur. It is to be hoped that the Agricultural Chemist will be able to make some headway with his necessary preliminary investigations this year. An important step was taken at the Agricultural Conference at Nagpur this year in the formation of a small committee to ensure the proper co-ordination of the work on reh, which is being undertaken in the most of the Provinces in India, and the consequent acceleration of practical results from thorough scientific investigation.

IV.—Hadi's Sugar-making Plant.

18. As mentioned in last year's report the demonstration carried out at Banga in February, 1908, could, by no means, be called successful and considerable doubt was expressed, if, in spite of the fact that the crop operated upon was a very poor one in quality, the plant could be made to pay in the Punjab even in normal seasons.

19. The plant was, therefore, with the approval of Government transferred to Lyallpur for closer observation. An excellent scheme for the rapid testing of its economic value for the whole of the Province was suggested by the Agricultural Chemist, Punjab. The main idea was to, first of all, test its relative efficiency on the Lyallpur cane crop and by a series of estimations of the average sugar contents of the chief cane-growing tracts to be able to state from the data of expenditure, etc., gathered from actual conditions whether the plant would have paid in any other district.

20. Unfortunately, only the former part of the scheme could be carried out as amongst breakages incurred in transit of the new Chemical Apparatus, the very instruments required for the purpose suffered serious damage and could not be repaired in the country. The Agricultural Chemist could, therefore, only test the relative efficiency of the plant, and that by a series of laborious analyses. As the full results are not to hand, I regret that they are not available for this report, but will be furnished in a separate note on the subject. I have, however, the results of the practical tests and may briefly state them here.

21. It may be noted that the crop this year was a good one, and would rank quite above that of average years.

22. The plant was this year worked during the day only and the working was directed mainly to suit the requirements of the Chemical analysis going on. The period of working was thus spread over a longer period than would have been necessary and the plant could not be, therefore, said to have been economically worked. The net loss to Government was, however, kept down by the almost exclusive use of farm labour on the crushing and boiling plants. Centrifugalling was done at its lowest possible cost by a system of labour contract which answered very well for the purpose. The estimate of expenditure for crushing and boiling given is based on actual conditions.

23. It may be at once stated that even working under the most economical conditions the plant could not have been made to pay. The forecasts based on last year's experience have been very accurately borne out.

24. These are briefly :—

(*a*). The high price of gur in the Province will not permit of obtaining the raw material at anything approaching Mr. Hadi's figures, quoted in his Bulletin No. 19, U. P., Agricultural Department.

(*b*). Labour in the Punjab is much above Mr. Hadi's estimates.

(*c*). The percentage of sugar to juice obtained by this process even in the best crops is far below Mr. Hadi's estimate for the United Provinces.

25. At the present stage and until the chemical examination has been completed, I do not wish to say much. It is, however, quite evident that Punjab conditions are not nearly so favourable for such a plant as those of the United Provinces, and the advantage of sugar as opposed to gur-making is not very apparent from the point of view of the zemindars. Both the cost of labour and the price of gur seem to have gone up permanently—possibly the former as a result of the latter. The quality of sugarcane very probably, has if anything, deteriorated. Refined sugar has fallen in

price. The result is that sugar-making as an industry has practically become extinct in the Province and it would appear from our experience that something more efficient than the Hadi process would be required to restore it. Very probably gur-making is more suitable for the country as a whole, as it fills a definite place in the food supply of the people and the average man is possibly better off in eating the molasses in gur than drinking it as country spirit. From the point of view of the zemindar the price of gur is unaffected by foreign sugar supplies, and in a bad year the high prices prevailing enable him to some extent to make up for the deficiency in outturn.

V.—Winnowing Machines.

26. It is very important that a good winnowing machine for wheat should be brought out, as it is almost certain that a demand for such will follow on the adoption of reaping machines. Some progress has this year been made towards this end and a machine specially built for the purpose has given double the efficiency of the best make previously tried. The actual figures, which a trial on last year's bhusa promised, have not been attained, owing to the abnormally coarse bhusa produced this year. Winnowing by the country process was equally tedious, but the advantages of the machine were not shown up, as they would have been in a normal year.

27. It is perhaps lucky that we should have encountered an exceptional year at the outset, as it is clear that alterations will have to be made to meet such emergencies. Late rains like those we had in the end of April this year will always have a similar effect on the bhusa. A new design to meet any emergency has been worked out by me and it is to be hoped that it will prove satisfactory, but the question is full of difficulties, and any low-priced machine suitable for the people of this country will necessarily have to be a compromise. The want of Agricultural Engineers is very actually felt in dealing with such a case. The great difficulties, which we have encountered this summer in testing the various determining factors and the crude methods we had to employ, compared with the facilities offered to me last year at home by an Agricultural Engineering firm constitute a great handicap to the carrying out of any important improvement in this country.

VI.—Trial of Steam Threshing Plant at Lyallpur.

28. The advantages of efficient and economic threshing by machinery in a great wheat producing Province like this are apparent to any one acquainted with the ordinary country methods. Some makers of steam threshing plants in England have for some years back tried with little success to introduce their machinery into the country. Messrs. Marshall and Sons, of Gainsborough, two years ago conducted trials near **Multan.** Not being satisfied with the result they have again this year with commendable enterprise returned to charge. The Department offered assistance at Lyallpur and provided the Farm crop of wheat and barley for experiment.

29. The firm's report on the trials promised some time ago, has not been received and their opinion as to the results are thus not as yet available for publication. Although the machine was successful in producing a good sample of both grain and bhusa, it is very evident that the heavy capital outlay on such plants, involving, as it does, a proportionally heavy charge for interest and depreciation combined with a short working season militates severely against their economic success. It is, however, better to reserve any definite opinion until the report of the firm is forthcoming.

VII.—Chrome leather of charsas for wells.

30. The question of giving a fair trial to "chrome leather" charsas has been taken up at the instigation of the Financial Commissioner, Punjab. Some years ago a few of these were distributed to Deputy Commissioners for trial, but the movement never got beyond its initial stages owing to their being condemned by the zamindars who used them. This year a few charsas have been distributed privately to zamindars in the Nawashehr tahsil of Jullundur. Trials are not complete, but it is satisfactory to note that those distributed are all doing well up to date.

VIII.—Distribution of castor cake for manurial purposes.

31. Small quantities of castor cake for manurial purposes have been distributed free of charge through the Deputy Commissioners of Jullundur, Hoshiarpur and Gurdaspur to selected zamindars. No previous trials of any value have been made at the Experimental Station, but castor cake has been used for some years near Lahore and found to be satisfactory. This is a case in which no harm can be done by such a distribution in the event of the users not deriving material benefit from the manure. In the event of success there is no reason why the available cake which at present is consigned from Lahore to Bombay for manurial puposes should not be used up in the Province.

IX.—Advice to Court of Wards Estates.

32. The question of adopting the advice given by the Board of Agriculture Meeting at Pusa in 1905 that the local Departments might undertake the "demonstration of high farming methods in the Court of Wards estates" has lately been the subject-matter of some correspondence, and it has been decided that action on the part of our Department should be confined to that of advising, where this can be done with advantage.

33. I have been able to make a start with the Mamdot estate, where the question of grass eradication has become a serious one both for the Estate and its tenants. Experiments with ploughing the land with deep furrow-turning ploughs have been started and, if successful, the estate ought to be able to bring back into cultivation many thousands of acres which have recently lapsed into grass. This will, in all probability, have to be carried out by means of steam tackle, as the draught necessary to cut and turn the extremely thick and tough sod which has rapidly developed, would be quite outside the capacity of the ordinary country cattle.

X.—Produce shows at Cattle Fairs and working exhibition of Implements, etc.

34. Several cattle fairs have now attached to them Agricultural Produce Shows. I attended four of these last cold weather. Possibly too much importance can easily be placed on such exhibitions and a great deal should not be expected of them. Failure to arouse enthusiasm over agricultural produce shows should not be considered a sign of want of enterprise on the part of the population as similar affairs rouse very little interest even in the best farmed counties at home. The true agriculturist will always take more interest in his live-stock and his crops than in seed and grain.

35. A small collection of implements has been sent to several fairs and on the whole has been the centre of a good deal of interest. I think cattle fair committees might well consider the advisability of developing this side. Possibly private firms, if encouraged, would be glad of the opportunity of exhibiting their machinery. The general effect would be perhaps more valuable as an educational factor than anything else. There is little doubt but what the excellent displays of implements at the more important cattle shows at home have done quite a lot to lessen the conservatism of the British farmer. Great care should, however, be taken in giving working exhibition of the Government agricultural implements and machines, and it should not be forgotten that in the presence of large crowds such are never seen at their best, and that any attempt to rush this section will end disastrously to those engaged in it.

XI.—The Jullundur Agricultural Station.

36. The land for the site of this station has already been acquired and rough plans and estimates for buildings, etc., have been prepared.

37. The land will be got as rapidly as possible into proper shape for comparative experiments, and I trust that no side issues will be allowed to interfere with this very necessary work.

XII.—Enquiry regarding fodder scarcity in the South-Eastern Punjab.

38. I regret that this enquiry has had to be postponed owing to the want of staff.

XIII.—General.

39. The work of the year can, on the whole, I think, be stated as fairly satisfactory. Complete failure has to be recorded with the sugar plant, but the Department has never approved of it, and it must not be forgotten that we were originally ordered to demonstrate it. The American cotton has had a good year, but I am not very sanguine as to its future. Otherwise we are on the whole on fairly sound lines. We have made a further step towards gaining the confidence of the Lyallpur zamindars by our success with reapers, etc., and have considerably increased our clientele, and if care is taken not to destroy this confidence by unduly pushing things, I think, in a short time we will have quite a large enough connection to be able to dispense with the demonstration farms, areas, etc., which have been found necessary in other Provinces to advertise agricultural improvements.

40. The chief need of this section of the Department is at present an adequate and properly trained staff of assistants, and I regret that several important questions which might lead to valuable results cannot be undertaken at present.

41. The above programme has been carried on by me practically unaided. I have from time to time had the services of two Agricultural Assistants, who have both worked conscientiously and to the best of their ability.

S. MILLIGAN,
Deputy Director of Agriculture,
Punjab.

APPENDIX VI.

ANNUAL REPORT OF THE PRINCIPAL, PUNJAB AGRICULTURAL COLLEGE, LYALLPUR, FOR THE YEAR ENDING JULY 31ST, 1909.

Prefatory.

1. I have but few points of interest to call attention to in my work as Principal of the College during the past year as the buildings are still in the hands of the Public Works Department. The greater part of my time has, however, been occupied with the College and its internal organisation, with the various subsidiary schemes now under construction or consideration and with the laying out of the College estate.

Grounds.

2. As I understand that the Director of Agriculture has dealt with the College buildings and their accessories in his report I shall pass on to the consideration of other points of interest. In the first place, efforts have been made under very adverse conditions to bring as much of the College grounds as possible under cultivation, though up to the present we have been unable to obtain control of more than a limited area, the bulk of the ground being still occupied with building materials. I anticipate it will take at least 12 months to clear up the whole estate and put it in order.

The opening of the College.

3. The Boarding House has been furnished and preparations made for its occupation by the students. It was intended to open the College on the 20th of July, but unfortunately neither the laboratories nor lecture theatres could be got ready by that date, and we had therefore to postpone the opening until the 1st of September when it is hoped all necessary accommodation will be available. A great deal of interest has been, and is being, taken in the College throughout the Province and I have had over 5,000 enquiries about the educational course and the terms of entrance, many from genuine candidates for admission.

Entrance Scholarships.

4. An Entrance Scholarships Examination for the 10 vacant divisional scholarships was held in the College buildings in the beginning of May. One-hundred and thirty-five candidates appeared in this competition examination and over 400 applications were received for the remaining six vacancies—a sufficient indication of the outside interest displayed in the College. Some of the points mentioned in the Examiners' report are of particular interest as bearing on our future work. No difficulty was experienced by the Examiners in allotting the scholarships, the successful candidates in every case being a long way ahead of the unsuccessful competitors. These successful candidates appeared on the whole to be a suitable class of students for the course which is to be given at Lyallpur, but with regard to the general run of the candidates Mr. Milligan remarks in his report that they could in no way be considered to possess a high enough standard of elementary education to benefit by the course of instruction set down in the College syllabus. I consider that the results of this examination have a very important bearing on our efforts to reach and maintain the standard we have set ourselves in the Punjab Diploma of Agriculture. I propose to make this matter the subject of special investigation and report. Another point of interest brought out in the Examiners' report was that in the oral examination a large number of candidates showed but a scanty acquaintance with indigenous farming operations. As these candidates were supposed to belong to the agricultural and landowning classes it is clear that the terms of admission will require some modification, and that the comparative value of the oral to the rest of the examination will have to be raised, otherwise the course from the agricultural point of view will require lengthening.

Staff.

5. There are at present four Assistant Professors on the staff—three have recently joined and one is still undergoing training at Pusa. I cannot report on their work as yet, but I anticipate that some years must elapse before the Indian Assistant Professors will be able to take a full share of the teaching duties and in the meantime these duties must fall heavily on the shoulders of the European staff.

Office.

6. The office work during the past year has increased very considerably and, though the staff has been added to by one librarian who helps in the accounts work, I find this section is still overworked.

J. H. BARNES,
Principal, Punjab Agricultural College,
Lyallpur.

P96n
1909/10

REPORT

ON THE

OPERATIONS OF THE DEPARTMENT

OF

AGRICULTURE,

PUNJAB,

For the year ending the 30th June, 1910.

Published by Authority.

Price : Annas 3 or 3d.

Lahore:
PRINTED AT THE "CIVIL AND MILITARY GAZETTE" PRESS
BY SAMUEL T. WESTON.
(Sole Contractors for Printing to the Punjab Government.)
1910.

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Proceedings of His Honour the Lieutenant-Governor of the Punjab in the Department of Revenue and Agriculture (Agriculture), No. 190, dated the 27th October 1910.

READ—

Letter No. 591 S., dated the 6th October 1910, from the Junior Secretary to the Financial Commissioner, Punjab, forwarding, with the comments of the Financial Commissioner, the annual report on the Department of Agriculture in the Punjab for the year ending 30th June 1910.

REMARKS.—During the year under report the Agricultural Department in the Punjab has extended its work in various directions. In spite of the shortage of qualified assistants the superior staff has found time to undertake, and to further, experiments in scientific agriculture which cannot fail to have far-reaching effects on the prosperity of the province. The proposals of the Director of Agriculture for improving the pay of the upper subordinate staff are receiving the careful consideration of Government, and the Lieutenant-Governor trusts that in two years' time the Punjab will be able to recruit its agricultural staff mainly, if not entirely, from students trained in the province.

2. The Punjab Agricultural College has now been open for a year. The large decrease in applications for admission need not, in His Honour's opinion, cause anxiety. It is better to proceed slowly in new ventures. Moreover, there is good reason to suppose that the large number of applications for admission last year was due in part to the novelty of the idea but mainly to the hope that the college would furnish a cheaper and shorter means of entrance to Government service, which of course is not in the least intended. That the students show themselves familiar with ordinary farming implements and their use is satisfactory as showing that we are getting the class of students for whom the college was intended. However, His Honour cordially approves the Director's proposal to enlist the assistance of district officers in bringing the advantages of the college to the notice of substantial land-owners, and special arrangements might perhaps be made for land-owner students from the Aitchison Chiefs' College.

3. Another new departure this year is the opening of the agricultural station at Gurdaspur. Up to date, experiments with seed and tillage have been mainly confined to the Canal Colonies, and while these, no doubt, offer a most favourable field for innovations, His Honour is anxious that the chances of improving the methods and staples of intensive cultivation should not be overlooked.

4. Experiments with wheat and cotton continue to absorb the attention of the Economic Botanist and the Professor of Agriculture. It is perhaps too soon to expect any definite results, but the Lieutenant-Governor trusts that Mr. Renouf's efforts to "strengthen" the wheat staple of the Punjab and attract the attention of English importers to its possibilities, will be successful. The standardisation of wheat, to which His Honour understands Mr. Milne is devoting himself, is a necessary part of the scheme for better storage and disposal of the surplus wheat crop, in which Sir Louis Dane takes especial interest.

5. The experiments with cassava are disappointing, but the other trials mentioned by the Economic Botanist should give useful results. His Honour will watch with interest the date-growing experiments in the south-west Punjab which originated from his inquiries into the cause of the failure of the experiments made in the eighties. These inquiries showed that the dates had been sown in unsuitable localities for the most part, in addition to the fact that date trees for fruit are rarely raised from seeds. Sir Louis Dane therefore suggested that the experiment should be repeated on the lines which have now been adopted, and he is glad to see that Mr. Milne, an expert in the subject, believes that there is every reason to hope for success.

6. The advance in the popularity of agricultural machines is very striking. The reapers are in a fair way to establish themselves as part of the equipment of an up-to-date zemindar, and the Raja plough has proved its usefulness It is to be hoped that Mr. Milligan's winnower will be equally successful. His Honour wishes to acknowledge the untiring efforts of Mr. Milligan in obtaining

a class of machinery which is suitable to the needs of the Punjab peasant. A gratifying proof of his success is to be found in the fact that the new machines have mostly been bought by the same villages which bought them last year. The attention of district officers should be drawn to the importance of exhibiting these machines at district cattle fairs and other local gatherings.

7. It is to be regretted that shortage of assistants has prevented the Agricultural Chemist from prosecuting to a definite conclusion his investigations into the cause and cure of salt efflorescence, but His Honour trusts that before long Mr. Barnes will be able to spare time for this important enquiry.

8. The exhibits of the Agricultural Department were a prominent and successful feature of the Lahore Exhibition of 1909. His Honour desires to thank the officers of the department for their loyal co-operation in preparing the exhibits and generally for their work throughout the year.

9. To Mr. Renouf in particular the acknowledgments of Government are due, and in reviewing the last report which he will submit as Director of Agriculture Sir Louis Dane wishes to express his sense of the energy and initiative which he has shown in organising a new department, and in adapting the talents of a specialised and highly technical staff to the needs of a peasant population.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Junior Secretary to the Financial Commissioner, Punjab, for information, that they be published in the *Punjab Gazette* and submitted to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant Governor,

R. HUMPHREYS,

Secretary to Government, Punjab.

Punjab Government Press, Lahore—27-10-10—1751—340—H. L. S.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING JUNE 30th, 1910.

Part I.—Administrative.

Introductory.

1. The work in the various sections of the Department has been dealt with at suitable length by the respective officers in charge, and, on most subjects, it is only necessary for me to write a brief summary or review.

Personal.

2. I held charge of the Department throughout the year. I spent 92 days on tour visiting the districts of Delhi, Gujranwala, Lahore, Gurdaspur, Attock, Multan, Shahpur, Ferozepore, Hissar and Jhelum and the Faridkot State. I also attended the meeting of the Board of Agriculture at Pusa.

Superior officers.

3. Mr. Milligan was in charge of the post of Deputy Director, and Mr. Milne of that of Economic Botanist. Mr. Barnes, Agricultural Chemist and Principal of the Agricultural College, was on leave on medical certificate from the 16th July to the 31st August, 1909. During this period, Mr. Milne officiated as Principal. Mr. Roberts succeeded Mr. Corbin as Professor of Agriculture on the 23rd August, 1909, and proceeded on 3 months' privilege leave on the 18th May, 1910, when Mr. Milligan took over his duties.

Staff of the general branch.

4. Bhai Sundar Singh, Assistant Director, has joined his appointment after two years' training at Pusa. We began the year with one officiating Manager and eight agricultural assistants. Three more agricultural assistants joined from the Cawnpore Agricultural College in April on completing their course, but one agricultural assistant left on obtaining an appointment at Pusa and one was promoted to laboratory assistant. So, at the close of the year, there were one officiating manager and 9 agricultural assistants. We are still very short of staff, especially in the sections of the Deputy Director and Professor of Agriculture, but 3 more agricultural assistants will pass out of Cawnpore next April, and, from 1912 onwards, we shall be able to draw on the Punjab Agricultural College.

College staff.

5. The staff of 5 Assistant Professors was complete at the close of the year, but there were only 2 Laboratory Assistants engaged out of 6 sanctioned.

Proposals to regrade the upper subordinate staff.

6. Mr. Barnes has represented the inadequacy of the pay offered to attract competent Laboratory Assistants, and the case is now before Government. At the request of the Financial Commissioner, proposals were put forward at the same time for regrading the upper subordinate staff, and a scheme has been submitted which follows the lines which have been adopted in Bombay and in the United Provinces.

Additions to clerical and other staff.

7. The additions sanctioned this year include 3 supervisors and 20 well-borers for the well-boring establishment, a date-grower and a *mali* for date growing experiments, a clerk for the Lyallpur Agricultural Station, and a setter, a *muqaddam* and 4 fieldmen for the entomological section.

Buildings.

8. The College buildings and equipment are very nearly complete. The only important items now left over are the workshop and the electric and refrigerating plants, all of which are in hand. Useful field stores have been provided for the Economic Botanist, and a few quarters have been built for laboratory and agricultural assistants.

Other work of the Director.

9. A wages survey was carried out in December. The analysis of the results occupied a great deal of time. A memorandum on the survey, reviewing the course of wages since annexation, has been printed as one of the permanent records of the Financial Commissioner. The usual reports, forecasts and periodical statistics of prices, rainfall and crops were issued. A bulletin was published on the cultivation of "stronger" wheats in the Punjab. Examinations in Hindustani for officers of the Veterinary and Agricultural Departments were held in October and April.

Inspections.

10. The work of the Department was inspected by the Financial Commissioner, Mr. Douie, and the Inspector-General of Agriculture, Mr. Mollison.

Part II.—The Punjab Agricultural College.—(See Appendix I.)

General results of the year.

11. The College was opened in September last with a class of 16 students. Thirteen appeared in the examination at the close of the year when 10 were declared qualified to proceed to the second year's course. The staff had many difficulties to contend with, and the results are satisfactory. It is encouraging to hear such a good report on the practical field work. This part of the course is perhaps the most important in its bearing on the future of the students and it is being very carefully developed.

Admissions in 1910.

12. A class of 24 has been admitted this year, but this is still below the maximum of 38 which has been fixed. A limit has been imposed by the temporary shortage of Boarding House accommodation as well as by the consideration that the staff of teachers and assistants has not been fully recruited and has to be trained. A full class of 38 would necessitate duplication for practical and laboratory work, and, until we have a trained staff, this would make an undue demand on the time of the Professors, who also have important research and executive duties to attend to.

Applications for admission.

13. The falling off in the number of applications for admission is remarkable. I agree with the Principal that this is largely due to the dissipation of the idea that the course will be an easy one, and that the diplomates of the College will be specially favoured in the matter of Government employment. A certain number of applicants were attracted by the consideration that the course only extends over 3 years, this resulting in the saving of a year's study and a year's fees. The fees have now been raised to make the cost of the diploma equal to that of a B. A. degree. The 3 years' course being particularly suitable for the education and training of students who will have large estates to administer, I propose to address Deputy Commissioners with a view to enlisting their co-operation in bringing the advantages of the College to the notice of substantial landowners with intelligent sons. If these young men will only work diligently, they should derive great benefit from their studies. For smaller landowners, it is hoped that a one year's practical course in vernacular will be started as soon as the College course has been properly established, that is, in 2 or 3 years.

Recent orders regarding the fees and the number of annual admissions.

14. The Boarding House fee has been raised to cover all expenses. In fixing a maximum of 38 admissions per annum, it has been decided that 28 vacancies will be reserved for the Punjab, 5 for Punjab Native States and 5 for the North-West Frontier Province. Punjab students will pay Rs. 144 per annum and others, Rs. 192 per annum.

Part III.—Agricultural Stations and Seed Farms.—(See Appendix II).

Lyallpur Agricultural Station. The Professor of Agriculture's Section.

15. The Professor of Agriculture's Section at the Lyallpur Agricultural Station is mainly devoted to tillage and manurial experiments. The experiments are still in a very early stage, but the value of careful tillage is already apparent. Further confirmatory trials are of course needed before definite recommendations can be made. Nitrate of lime is not likely to pay at current prices. The poultry section has been started, but there has been serious mortality among the English birds during the summer. The work done on reapers and ploughs has won the confidence of agriculturists and the large number of visitors and enquirers is a very satisfactory feature.

As above. The Economic Botanist's Section.

16. Wheat and cotton are naturally claiming most attention in the Botanical Section and they are being dealt with on a comprehensive scale. A few selected varieties have been handed over to the Professor of Agriculture to grow on larger areas. The experiments with jute show that the retting difficulties are so great in this Province that no further progress can be made until there is a cheap machine to extract the fibre. In Lower Bengal, there is an abundance of water in the retting season, and the temperature is suitable. Agriculturally, *san* hemp would be a sounder crop to grow in the Punjab. The fibre is more valuable and is more rapidly retted. The crop also benefits the land instead of impoverishing it as in the case of jute. But the actual stripping of the fibre is most tedious. The Economic Botanist's work was unfortunately put back by the Exhibition.

The Eastern Punjab Agricultural Station.

17. Mainly on account of the large sum involved in acquiring the land selected near Jullundur for the Eastern Punjab Agricultural Station, and in providing farm buildings and a residence and an office for the Deputy Director, it was decided to locate the station at Gurdaspur where there is a considerable area of suitable Government land available and where there are also some Government buildings which can be utilised. The small area which will have to be purchased to make up 100 acres will not cost more than Rs. 5,000 and the new scheme permits of a large saving. Work at the agricultural station has begun and the headquarters of the Deputy Director are to be moved to Gurdaspur on September 1st, 1910.

The Sargodha seed farm.

18. The report of the Sargodha seed farm has not been received. I inspected the accounts and found them in order. I also visited the farm on two occasions.

Part IV.—Demonstrations and other operations connected with Agricultural Implements.

(*a*).—New and improved varieties of crops, etc.

Operations with American cotton, paragraphs 6 and 7 of Appendix III.

19. 1908 was a favourable year for American cotton, and cultivators were thus encouraged to sow a larger area in 1909. This advance, however, does not appear to be quite maintained in 1910 as *desi* cotton proved so profitable in 1909. 5,596 maunds were sold at auctions at Sargodha and Lyallpur, and, including private sales, the total outturn was probably 7,000 maunds. This is a quantity

sufficiently large for business firms to handle, but, in spite of this, progress in establishing a market is very slow. A slightly higher price than that realised, as well as ordinary marketing facilities, are needed to ensure cultivation on a really considerable scale. The question arises whether the cotton is worth more than the price realised at the auctions. The need of new sources of supply for the English mills may perhaps lead to the English cotton associations giving attention to the Punjab as a possible source of supply. All the assistance required in this Province is that arrangements should be made to buy the cotton at fair market rates whenever presented. Incidentally, it should be mentioned that it is hoped that the work in progress at the Lyallpur Agricultural Station will give the cultivator a somewhat better variety as regards outturn and staple than that which we now have. For the present, fresh seed is obtained from Dharwar every year.

Distribution of seed of indigenous cotton in Hissar.

20. The result of Mr. Townsend's comparative experiments with his selected cotton seed and ordinary bazar seed is that the selected seed gave 6½ maunds per acre, whereas the bazar seed gave 6 maunds. This is not a great increase, and good seed purchased from the best growers would probably have done as well as the selected seed. I agree with Mr. Townsend that it is better to abandon the attempt at scientific selection by the district staff and to consider if it is feasible to buy large quantities of good cotton and retail the seed. This might perhaps be done by co-operative action. I shall discuss this with Mr. Townsend during the cold weather. Mr. Townsend purchased 80 maunds of the best unginned cotton in this way and states that he sold the seed at a premium.

Advice to Court of Wards Estates, paragraph 11 of Appendix III.

21. It was only possible for the Deputy Director to examine the agricultural conditions of 2 Court of Wards Estates. The reclamation operations by means of steam ploughs recommended for Mamdot would have far reaching results, as similar difficulties in the eradication of weed grasses are reported from other districts. The matter is being considered by the Mamdot Estate authorities. Action will be compulsory sooner or later to prevent a large area from going completely out of cultivation.

Other points in the Deputy Director's report, Appendix III.

22. Castor cake has done particularly well with potatoes (paragraph 10). Its value for this crop is recognised in the United Provinces. There is a moderate quantity available in the Punjab, and it seems probable that it will all be taken up soon for potatoes and sugarcane. Sales in the Lahore District have risen from 834 maunds to 9,629 maunds in 3 years. Progress with the *reh* question is still delayed pending the staffing of the chemical laboratory (paragraph 14).

Cassavas, paragraph 4 of Appendix V.

23. A very thorough trial was given by the Economic Botanist to many varieties of cassava at 4 representative centres in Gurgaon, Ambala, Gurdaspur and Lyallpur. It is apparent that the crop cannot grow without irrigation. The result at Pathankot on dry land is hardly reliable as the season was exceptionally wet throughout. The outturns of 10,000 pounds of fresh roots per acre with irrigation are estimated on the assumption that there is no damage by white ants. Actual outturns per acre were very poor indeed owing to the attacks of white ants. Further trials are required before definite conclusions can be stated, and these are being undertaken. In particular, it is necessary to ascertain if there is a practical method of protecting the sets against white ants.

Date cultivation, see paragraph 3 of Appendix V.

24. The sanction of Government has been obtained to the employment of an experienced date-grower from Basrah for 3 years with a view to the introduction of improved methods of date cultivation in the South-West Punjab. He is expected to arrive early in September. Suckers of the best Persian Gulf varieties will be imported and planted in the Multan and Muzaffargarh districts, at the Multan Central Jail and in the Muzaffargarh District Board garden. The best varieties obtainable locally will also be collected in these gardens. Enquiries made last autumn show that there are some distinctly superior qualities in private gardens. But these appear to be jealously guarded. The climate of the South-West Punjab with a very light monsoon rainfall of 3½ to 5 inches, is very suitable for

date cultivation, but, as a rule, although the date crop is of great economic value to the tract, forming the main food of the people for a season, the date trees are allowed to grow absolutely wild. With care in planting good varieties, in propagating from suckers instead of from seeds, in fertilising the flowers of the female plants artificially, in general cultivation, and in preserving the fruits, it should be possible to greatly improve the quality of the produce and to make the date crop a very valuable asset to the Province. It will be some years before suckers from the improved varieties are available for distribution or sale. But, in the meantime, improved methods of cultivation and of preserving fruit will be tested in local date groves, and the working up of the bye-products of the date palm (rope and basket-making, etc.) will also be gone into.

(*b*).—AGRICULTURAL MACHINERY.

Agricultural machinery, Appendix III.

25. It is unnecessary to add much to Mr. Milligan's interesting remarks on agricultural machinery in paragraphs 2 to 5 of his report. With the ever increasing cost of labour, the need of labour-saving appliances becomes greater every year. Tillage implements are also required which will prepare the land more rapidly and more thoroughly than the *desi* plough. Mr. Milligan has devoted the greater part of his time to these important matters which are probably the most pressing and most promising subjects of enquiry before the Department. The Punjabi has become accustomed to farming for a profit as well as for a livelihood, and he is prepared to invest a certain amount of capital if he sees his way to a good return. This branch of the work of the Department is very promising indeed.

Reapers, paragraph 3 of Appendix III.

26. The sale of as many as 72 reapers is quite satisfactory. It is no small enterprise for a cultivator unaccustomed to machinery to lay out such a large sum as Rs. 255 on a machine which, to him, must appear somewhat complicated.

'Raja' ploughs, paragraph 3 of Appendix III.

27. Over 200 light, furrow-turning ploughs have been sold and the 'Raja' plough may be regarded as an established success for certain classes of soil. In this case, as with other implements, no pressure is brought to bear on enquirers. Every facility is given in the way of practical instruction and demonstrations, but sales of implements are entirely on their merits. The reaper and plough are therefore on a very good footing, and there appears to be good reason to anticipate that their use will spread with increasing rapidity. We should soon have a sufficient number of conclusive results to justify the active advertisement of the advantages of these machines.

Spring-toothed harrows, paragraph 4 of Appendix III.

28. Much attention has been directed of late to the advantage of ploughing in May and early June for the following wheat crop. The value of this practice is fully recognised by the agricultural population and has found expression in many agricultural proverbs. But it has remained generally a counsel of perfection owing to the difficulty of finding time for ploughing during the wheat harvest and of obtaining water. A large area has been treated with the spring-toothed harrow at Lyallpur this summer, and we shall have the results next year. If the harrow is an economic success, it should have a very wide sale.

Other implements.

29. It is gratifying to learn that Mr. Milligan's new design for a winnower has given excellent results. Its progress will be followed with interest. There is no scope at present for a steam thresher, although simple and cheap threshing machinery might become popular.

Demonstrations of machinery.

30. Demonstrations of working machinery and instruction have largely occupied the time of the Deputy Director's staff. There was of course a prolonged demonstration at Lahore during the Exhibition. More demonstrations will be given at fairs this year. The successful introduction of improved implements depends largely on the assistance and instruction which is given to agriculturists in their management and care.

The Machinery Depôt, ee paragraph 4 of Ap-
endix IV.

31. The Machinery Depôt did valuable pioneering work and brought in a profit of Rs. 657-8-10 up to the 31st March, 1910.

32. We are indebted to Messrs. Volkarts for the thorough and business-like manner in which they have handled the various implements which we have recommended and for which they have undertaken the agency. They had an excellent exhibit at the Lahore Exhibition and their illustrative descriptive pamphlets in English, Urdu and Punjabi have done much to spread information.

Sale of approved implements by Messrs. Volkart Brothers.

33. The well-boring staff was sanctioned in November, but, owing to pressure of Exhibition work, supervisors were not engaged until April. The Director of Agriculture in the United Provinces having kindly agreed to give the supervisors training, they were deputed to the United Provinces for 3 months, and, on their return, they proceeded to select and train 10 well-borers as a beginning. Parties are being sent to the 4 districts in which a start will be made. No time will be lost in expanding the staff to its full strength and in extending the work to other districts. Rules, forms and registers have been printed in English and vernacular and a stock of apparatus has been purchased. Experimental work by the Public Works Department in the last two years in going down to lower water bearing strata has given very encouraging results.

Well-boring, paragraph 13 of Appendix III.

Part V.—Entomology.—(See Appendix VI).

34. Sheikh Ghulam Sadiq's enterprise in distributing 200 ounces of eggs obtained from France in Gurdaspur, did not meet with the success which it deserved. Each rearer insisted on taking at least four times as much seed as he could deal with, and the outturns per ounce were very low. An assistant was posted to Gurdaspur and Messrs. Milne and Carson also made visits. Progress in convincing the Gurdaspur rearers that their methods are susceptible of great improvement will be very slow. I should not be surprised if they remained obdurate. But the fact stands out that sericulture has persisted as an industry in parts of Gurdaspur, and that it has been profitable even with diseased seed and defective methods. There is every reason, therefore, to persevere in submontane tracts. Sheikh Ghulam Sadiq is not discouraged. He is purchasing 300 ounces of eggs this year through the Department and he is arranging to reel his silk on improved methods. Private trials are being made in Hoshiarpur and Jhelum. The Irrigation Department are assisting by planting mulberries along the upper reaches of canals in Gurdaspur, Ludhiana and Ambala. The Settlement Officer of Ludhiana has interested himself in the matter, and he sent 3 intelligent Jats to Lyallpur to learn silkworm rearing. Villages in which there are a sufficient number of mulberry trees have been marked down. Practical demonstrations of rearing will be given in selected centres next spring. These will be sufficiently few to permit of adequate supervision. The assistance of Irrigation Officers and of the Settlement Officer, Ludhiana, is promised. Once correct methods have been introduced, rapid extension will be easy. There is far more hope of establishing sound practices in entirely new districts than in eradicating defects in Gurdaspur. An adequate food supply being the first condition of success, a letter was addressed in April to the Deputy Commissioners of 9 submontane districts, pointing out the feasibility of introducing sericulture if the people thought it worth their while to incur the amount of trouble involved in silkworm rearing, and suggesting that District Boards should plant mulberries as roadside trees wherever there is enough soil moisture or a little irrigation. Seed and cuttings of Italian mulberry are being tried as well as cuttings of Mysore and Philippine mulberry. It is also proposed to experiment with Japanese and Bengal bush mulberry at Lyallpur.

Sericulture, paragraph 5 of Appendix VI.

The experiment at Lyallpur this year with 1½ ounces of seed gave 36½ seers of green cocoons and 12 seers 14¾ chittacks of dry cocoons. Last year, one ounce gave 48¼ seers of green cocoons and 15¼ seers of dry cocoons. The percentage lost in dryage is about the same. The falling off in the outturn by 44 per cent. is attributed to late hatching which resulted in the silkworms suffering in a hot wave in April. It is a pity that the hatching was late, but we have, at all events a striking illustration of the consequences of delay.

Other entomological work.

35. Bee-keeping has been placed on an encouraging basis in Simla where an association for mutual help has been formed. The time for field work in connection with pests was restricted, but it should be possible to do more this year.

Part VI.—Miscellaneous.

The wheat trade.

36. Further reports from Mr. and Mrs. Howard confirm the view that the agricultural conditions of Northern India are more suited to the production of stronger wheats than of the weak varieties now exported. A bulletin based on Mr. and Mrs. Howard's conclusions and on enquiries from the Karachi Chamber of Commerce and the Association of British and Irish Millers was issued during the year. A great deal has now been done to direct attention to the fact that wheat traders are pursuing a wrong policy in offering a premium for the weaker wheats. At present, Punjab wheats leave Karachi in the form of standard mixtures which are made up at Karachi from the consignments received from up-country. The first step is for the exporters to offer the higher rates for the "stronger" mixtures and thus stimulate their cultivation. Agriculturists would respond at once. The next step to the cultivation of pure samples would probably not be a difficult one. The success obtained so easily in reducing the percentage of admixture should furnish an encouragement to further efforts. But, as long as exporters decline to ship or purchase pure lots of the better wheats, it is difficult, if not impossible, for the Agricultural Department to get them grown for export. Co-operation among the growers may be feasible with a view to placing large consignments of uniform quality on the market, provided, however, that the trade responds suitably. At the suggestion of Sir James Wilson, we are considering the despatch of fairly large consignments of the stronger wheats to certain millers in Scotland, who have expressed their willingness to purchase them, to give them a working trial, and to furnish a report. These consignments will, it is hoped, do much to convince the home millers that the Punjab can produce better wheats than the mixtures now exported. The Wheat Elevator Committee has recommended the trial of an elevator at Lyallpur and the erection of a large elevator at Karachi. If the elevator system could be introduced, it would greatly benefit the wheat export trade. It would lead to the shipping of wheat in much better condition as regards admixture of earth and foreign seeds, and it would tend strongly towards the separation of the better grades.

The work of the Agricultural Chemist, Appendix VII.

37. The Agricultural Chemist has practically been unable to make a start with his laboratory work owing to the difficulty in securing competent assistants. But the duties of the Principalship in the first year of the College were so heavy that he would not have had much time for his laboratory.

The Indian Industrial and Agricultural Exhibition, 1909.

38. The preparation of the Agricultural section of the Indian Agricultural and Industrial Exhibition was practically entirely the work of the Agricultural and Veterinary Departments. A full report on each section has been sent to the Exhibition authorities for incorporation in the official report and it is sufficient to give here a very brief sketch of the scope of the exhibits. Mr. Milligan provided a collection of indigenous implements from all over India. He also gave daily demonstrations of improved implements including ploughs, cultivators, harrows, chaff-cutters, and, among water lifts, a chain pump, a self-delivery *charsa*, and an archimedean screw. Mr. Milne organised the products section, the exhibits of grains, fibres, oil-seeds, oil-cakes, drugs, etc, being systematically shown in sections and groups. The principal products of each Punjab district were collected, and specimens were obtained from other provinces, and, where possible, from foreign countries. The wheat and cotton collections attracted most attention. The Tea Cess Committee provided a very interesting stall. The entomological and mycological sections were also under Mr. Milne's control. The entomological section, for which Mr. Carson was largely responsible, was very complete. A silk-reeling demonstration should be mentioned. A special glass house was devoted to bee-keeping on modern lines, and explanations were given daily. The Pusa Research Institute lent a number of instructive cases illustrating plant

diseases. My office prepared a complete collection of provincial agricultural statistics with diagrams and maps. Mr. Roberts, Professor of Agriculture, contributed a poultry exhibit. The incubator house with incubators and a foster-mother were perhaps the most popular items in the Exhibition. A model of a grain elevator was made by Captain Osborne, R.E., and a special attendant was provided to answer enquiries. The horticultural exhibit by Mr. Robertson Brown was the first of its kind in India. The exhibits were very effectively arranged and were comprehensive and suggestive. Major Walker, Chief Superintendent, Civil Veterinary Department, showed a model of a veterinary hospital, the equipment of a veterinary hospital and a large collection of cattle foods and fodder grasses. Major Smith, Principal, Punjab Veterinary College, lent the College collection of anatomical models, some interesting skeletons, a collection of bacteria which attack cattle, and a number of diagrams. These were greatly appreciated. Assistants were on duty in all sections to give information to visitors. Descriptive labels in English, Urdu and Gurmukhi were provided throughout. It is to be regretted that the time allowed for preparation was short. The Department was further handicapped by the fact that it has only recently been organised and had no previous collections to fall back upon. In spite of these difficulties, the section was an excellent one, and was one of the best in the Exhibition. This was the heaviest undertaking of the year for the Agricultural Department. The brunt of the work was borne by the Deputy Director and the Economic Botanist, their time being absolutely monopolised by the Exhibition for several months. The Department is, however, not without a substantial return for its efforts. The College museum has been very well stocked, and we have been brought into contact with a much larger public.

Agricultural associations.

39. The Townsend Agricultural Society have succeeded in reducing the number of worthless bulls in villages, many having been driven away to Bikaner or made over to "*gaosalas.*" The society have 5 camel stallions, including 2 provided by Government last year, and these covered 250 she-camels during the cold weather. They are reported to have been extremely popular with zamindars, and it is said that 1,000 she-camels could have been covered had stallions been available. The Lyallpur Agricultural Association held 2 meetings.

Shows of agricultural produce.

40. There were small shows of agricultural produce at the Lyallpur, Ferozepore, Ambala and Karnal cattle fairs. Implements were shown working at these fairs and also at those held at Sargodha and Gujrat.

Lease of land for a private poultry farm.

41. A lease of land on favourable terms was given to Duffadar Ghulam Muhammad for a poultry farm near Lahore. With the present high prices for fowls and eggs, it will be an advantage to the community to stimulate production. Duffadar Ghulam Muhammad's pioneer venture merits success. If it proves profitable, it will doubtless find many imitators.

District gardens.

42. The accounts for the year ending March 31st, 1910, of the 4 gardens noticed annually in this report are as follows :—

	Income.	Expenditure.
	Rs.	Rs.
Shahdara	45	11,755
Shalimar	1,613	6,420
Kudsia	623	2,770
Roshanara	3,219	2,580

The Mahasu orchards.

43. The arrangements for the management of the Mahasu orchards and the issue of young fruit trees for fruit culture in the hills remain unchanged. Applications were received for 7,038 fruit trees and 3,333 were actually supplied.

General.

44. All the officers of the Department deserve credit for their work in what has been a very arduous year. Special acknowledgments are due to those who took a share in the Exhibition, and in particular to Messrs. Milligan and Milne. Lastly, I should express our great

obligation to the Provincial Departments of Agriculture in India, to the Pusa Research Institute, and to the Deputy Commissioners of all Punjab districts, without whose assistance it would have been impossible to make the various collections for the Exhibition.

Review of the progress of the past 7 years.

45. This is the last occasion on which I shall have the pleasure of submitting the annual report of the Agricultural Department. I have had charge of the Department since its formation as a separate Department in 1906, and, before that, I was in charge of the joint Department of Land Records and Agriculture for 3 years. I trust, therefore, that I shall be permitted to give the briefest possible summary of the developments which have taken place. On the Veterinary side, the Punjab Veterinary College in 1902 had two English officers, and there were 128 students. With Colonel Pease, C.I.E., and Major Smith as Principals, very material progress has been made. The Ajmer Veterinary School was absorbed in 1904 and there are now three English officers, a much larger Indian staff, and 249 students. The buildings have been greatly improved, and a considerable amount of useful research work is being carried out. Further developments are imminent in connection with this institution. The Provincial Veterinary Department, which has been under the capable and energetic control of Major Walker, had a staff of one Superintendent and 56 assistants for work with cattle in 1902-03. There were 8 hospitals at which 15,863 animals were treated in the year, while 30,939 animals were treated in villages. We now have 2 whole-time Superintendents, and we share a third with the North-West Frontier Province. There are 12 inspectors and 135 assistants. There are 94 well-equipped hospitals at which 199,166 animals were treated last year, while 97,275 animals were dealt with in villages. Inoculation has been made promptly available in all outbreaks of rinderpest. A great advance has been effected in the supply of horse and donkey stallions and bulls for breeding. The Department has fully maintained its lead among the Provincial Veterinary Departments. On the Agricultural side, an entirely new Department has had to be formed in the last 4 years. The superior staff has been recruited and cadres have been sanctioned for the upper subordinate staff which should be filled in a few years. The Agricultural College and Research Institute at Lyallpur has been built and equipped, and the College course is now in its second year. There are two agricultural stations. The difficulties and delays inherent in original organisation are now practically over. Definite results must wait on enquiry, research and experiment, but the present report shows the progress made by the officers of the Department in the organisation and training of their sections and the numerous directions in which work has been initiated. In respect of implements, there is gratifying evidence that the labours of Mr. Milligan are already bearing fruit. I am confident that there is a bright future of useful service to the agriculturist of the Province before both the Veterinary and Agricultural Departments. There only remains for me to express once more my warm recognition of the services of the officers and staff of the Department during my incumbency.

W. RENOUF, C.S.,
Director of Agriculture, Punjab.

APPENDIX I.—(SEE PART II.)

ANNUAL REPORT OF THE PRINCIPAL, PUNJAB AGRICULTURAL COLLEGE, FOR THE YEAR ENDING JUNE 30TH 1910.

Introductory.

1. The report for the year ending June, 1910, of the Punjab Agricultural College is of interest as this is the first year I am able to record experience of working conditions with students in residence. As the first year of a new college, it has been a trying time for both staff and students, but the course has on the whole been fairly successful, 77 per cent. of the students being judged competent to pass on to the 2nd year's course.

Terms.

2. The session 1909-10 commenced on the 1st September, 1909, with a class of 16 students, 10 of whom were scholarship holders, and continued until the 20th of May, 1910, with such vacations as are notified in the College syllabus. During the session, 3 students withdrew from the course. As the Public Works Department were still engaged in some of the internal fittings at the time of the opening of the College and continued to occupy some of the rooms and laboratories for the first half of the session, some inconvenience was necessarily experienced by the teaching staff during this period.

Course of study.

3. During the year, there has been only one course of instruction given, namely, the subjects of the 1st year's diploma course for the Licentiate of Agriculture, consisting of lectures and practical classes in Agriculture, Chemistry, Physics, Botany, Entomology and Mathematics. The course has been fairly successful as a whole considering the disadvantage under which we have worked this year.

Practical Agriculture.

4. In the subject of Agriculture, I have much pleasure in reporting that in the practical agricultural class most of the students soon proved themselves to be familiar with the country farming implements and their use, and the preliminary work found necessary in other agricultural colleges in India was not required. In the subject of practical agriculture, the students were first familiarised with the use of improved implements and then placed in charge of plots of land (2 students to the acre) on which they have carried out the whole of the farming operations of the year. The interest taken by the students in this part of their work and the progress made is particularly encouraging.

Science subjects.

5. In the science subjects, the students as a whole showed great difficulty in grasping the nature of each subject during the first four or five months and were consequently very backward. But, during the latter half of the session, they began to improve. The general experience gained has been to the effect that the students, when they come to us, are backward in English and lacking in manual dexterity. This experience is borne out by that gained at other agricultural colleges throughout India and led to the proposal at the last Board of Agriculture that, some attention should be given by the Educational Department to manual training in the elementary schools of boys likely to enter agricultural colleges.

Entrance scholarship examination and applications for entrance.

6. An entrance scholarship examination was held during the first week of May. 32 nomination forms only were received from Deputy Commissioners and 20 candidates only presented themselves for examination. The competition from the Delhi and Rawalpindi Divisions was very slight, only 2 candidates appearing from each of these divisions for the two scholarships allotted to each. In the case of the Rawalpindi Division, one of the successful candidates resigned after being awarded a scholarship. A comparison of the number of applications for scholarships, 135 in 1909 with 32 in 1910, and of the applications for entrance, *viz.*, 439 in 1909 and 60 in 1910, shows a great falling off in the apparent popularity of the College. This may be due in part to the comparatively high educational standard adopted and the consequent disillusionment of the idea that the Agricultural College course will prove an easy road to Government employment. But, in addition to this, the class of boy applying for entrance this year is not so good as in 1909. I would urge the desirability of interesting District Officers in the Agricultural College with the object of inducing likely land owners to send their sons here for education.

Caste of Students.

7. On the 30th June 1910, the students on the College roll numbered 10 students in the 2nd year class and 25 in the 1st year class or 35 in all as follows :—

Hindus	12
Muhammadans	12
Sikhs	11
Total	35

Staff.

8. Some changes have taken place in the staff during this session. The assistant professor of chemistry, Ch. Zaka Ullah, has resigned and has been replaced by Bhai Jagat Singh, a graduate of the Punjab University, while the biological section has been strengthened by the appointment of Mr. J. Mitter, lately one of Dr. Butler's assistants, as assistant professor of mycology. The workshop staff has not yet been filled up to the sanctioned scale, as it was considered inadvisable to appoint this staff until full employment could be found for them, and this will not be until the workshops are complete or nearly so.

Teaching collection of plants.

9. The plans for a teaching collection of plants have been drawn up by the Professor of Economic Botany. The ground has been laid out and a number of the plants have been planted. The collection when complete will cover about 4½ acres. It will consist of plants of Economic or Biological interest planted so that those most nearly related according to Engler and Prantel's system of classification shall grow nearest each other. Thus, from the relative positions of any two plants, a student will realise their relationships without the aid of a book, while the characters of those plants most nearly related will be strikingly compared. Arrangements have also been made for the shade loving, and the most lowly forms of interesting plants, while ordinary farm crops and weeds will be seen in the fields and in the Herbarium.

The college buildings.

10. The college buildings and internal fittings have been completed and handed over by the Public Works Department during the year, and little remains to be done now but the installation of the electric plant and minor fittings and alterations. The fitting out and equipment of the museum, library and herbarium have been commenced. At the end of July, 1910, the library consisted of 4,686 volumes of scientific and general literature bearing on agricultural science, while the museum has been assisted by collections and presentations from the Lahore Exhibition.

Boarding-house.

11. The accommodation provided for housing the students has not proved sufficient to take in the 2nd year's full complement of scholars and I have consequently asked for its extension on a somewhat improved plan. The hostel has during the past year been under the superintendentship of one of the assistant professors and rules have been framed for its working. The health of the students has on the whole been good and we have been free from any serious disorder, though the boys suffer a good deal from fever during the months of September and October. During the year, the fees of the boarding-house have been raised from Re. 1 per month to Rs. 32 per annum and the hostel servants are now paid by the students' mess. This has made the hostel self-supporting and has cleared Government of any recurring expenditure in connection with it. In connection with the hostel, athletic grounds for cricket, hockey and football are being laid out and will be in use during the forthcoming cold weather.

Workshop and electric plant.

12. Most of the machines and fittings for the workshop have been received and are ready for erection. The workshop buildings have commenced and should be complete within the next 3 or 4 months. The installation of the electric plant will take somewhat longer. When this work and the hostel extensions are finished, which should be sometime during next cold weather the College buildings should be complete.

Grounds.

13. During the year, the college grounds have been under preparation for planting with shrubs and grass. A good deal of expense has been incurred in clearing the estate after its vacation by the Public Works Department in order to render it level and fit for irrigation. The supply of canal water for the college grounds has during the last year proved wholly inadequate and proposals are being made for an increased allowance.

Income.

14. The income paid into the Government Treasury during the year was Rs. 763-11-0.

Expenditure.

15. The contingent expenditure of the Principal's office amounts to Rs. 22,676-8-6 during 1909-10 as compared with Rs. 8,675-6 0 in 1908-09. The expenditure is necessarily very heavy during the first few years of a new college and research institute of this kind. We shall require some three years further experience, that is about two years' experience with a full complement of students and fully completed and equipped buildings, before we can gauge our annual expenditure with any degree of accuracy.

J. H. BARNES,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.—(See Part III.)

REPORT ON THE ADMINISTRATION OF THE LYALLPUR AGRICULTURAL STATION FOR THE YEAR 1909-10.

Section under the Professor of Agriculture.

Administration.

1. Munshi Ijaz Husain, Manager, was transferred to Pusa in February, 1910. Chaudhri Mohamed Abdullah was appointed Manager from February, 1910. The purely experimental area of the Farm, has been increased by 16 acres, the remaining area being still in the hands of yearly tenants.

Income and expenditure.

2. The gross receipts of the Station totalled Rs. 9,786-10-0 and the expenditure Rs. 10,349 as compared with Rs. 6,315 and Rs. 11,111 last year. The proceeds from wheat and barley show an increase of Rs. 2,180, over the preceding year, and from cotton Rs. 831, owing to good crops and high prices.

Poultry section.

3. The poultry Farm has been considerably enlarged. Various exotic breeds are being kept and observed carefully with the object of forming a basis for crossing experiments. They have all suffered severely during the hot weather in May and June.

Scheme of work.

4. The cropping experiments have dealt mainly with :—

(*i*) Tillage and its effects on cotton, wheat and sugarcane.

(*ii*) The direct manuring of wheat and sugarcane and the residual effects of manures on cotton and maize.

(*iii*) Variety trials of wheat and cotton.

The general management of field experiments has shown the great difficulty of producing equable conditions in experimental plots and the necessity of simplifying the eliminative process.

General results.

5. The following points brought out in the general management of the station deserve notice :—

General remarks.

(*a*) Sub-soiling has given no results up to date.

(*b*) Ploughing with furrow turning ploughs if judiciously handled, has been profitable and will pay the increased initial outlay in one year.

(*c*) Nitrate of lime has given a definite increase with wheat but not enough to pay for its application at the present cost of the manure.

(*d*) The value of the work on wheat initiated by Mr. Howard regarding the separation of types is becoming increasingly apparent. It has been quite clearly established that the popular mixtures which go under the name of Lal Kasarwali contain undesirable types and that pure samples or a mixture of the desirable elements would give better results.

(*e*) The primary importance of careful tillage can be seen by a comparison of the outturn of the land under direct management and that under tenants. On the unmanured land under direct control the average wheat outturn was 19¼ maunds while on that under tenants it averaged 12½ maunds, a difference of 6¾ maunds per acre.

(*f*) The value of deeper tillage for Kharif crops generally seems to be indicated by general observations.

(*g*) The necessity of growing wheats of good standing properties was very clearly brought out on the variety plots. One heavily lodged crop cost Rs. 10 per acre to reap by hand, while a better standing variety alongside reaped by machine only cost Rs. 1-8-0.

Visits by agriculturists.

6. The numbers of visitors to the Station continues to increase. The classes of instruction in the use of improved implements held by the Deputy Director has brought in large numbers of Zamindars who have had the opportunity of seeing over the Experimental areas.

S. MILLIGAN,

Offg. Professor of Agriculture, P. A. C., Lyallpur.

SECTION UNDER ECONOMIC BOTANIST, PUNJAB.

Land.

1. Of the 65 acres of land now in the section, 30 acres have been laid out in three plots reserved for wheats and cottons. Their fertility will be maintained approximately equal to that of zamindari land. Four and a half acres are under the teaching collection of plants (see College Report), and about 15 acres will be put under provincial fruit trees. The remainder will be used for miscellaneous experiments.

Water inlets.

2. Brick work inlets have been made in the field water channels. They are fitted with wire gauge screens to prevent as far as possible stray seeds getting into the experimental plots. These effect a great saving in labour and prevent the havoc wrought to plots by labourers while closing up the channels.

Stores.

3. Field Stores and accessory buildings have just been built.

Dwelling houses.

4. The foundations of dwelling houses for assistants have just been laid. They will be invaluable, as the men will be saved from long tramps with exposure to the sun, and will be on the spot night and day to attend irrigations, etc.

Field staff.

5. This consists of four agricultural assistants with a number of labourers. One Agricultural Assistant will act as manager of lands, labour, etc., another, will be responsible for work on cottons; a third, for work on wheats; and the fourth, for various other experiments. All will assist each other in busy seasons. Under this arrangement the men work most keenly. Three assistants joined a year ago and one only a few months ago. All have worked very hard and have cheerfully undertaken the vast amount of overtime work which we have had to do.

Menial labour and expenses of working the section.

6. Efforts are being made to replace the temporary labour by permanent labour as far as possible. The menial labour is paid from the budget of the Professor of Agriculture. The expense of working the section will be included in his administrative report.

Cottons.

7. Fifteen acres were under cottons. The land was extremely poor and rather uneven. It was only handed over to the section a few weeks before the cottons were sown. About 700 varieties were sown, but owing to the Lahore Industrial and Agricultural Exhibition practically monopolising the whole of our time during the cotton season, the work done amongst them was limited.

Samples of 16 acclimatised American cottons, of 4 Upland American cottons imported last year, and of 4 native cottons, were sent to the Chairman of the British Cotton Growing Association, Liverpool, for valuation. The samples of the three best acclimatised American varieties were valued at 8·00*d.* to 8·25*d.* per pound; three second class samples were valued at 7·10 to 7·20*d.* per pound. The four Upland American cottons imported last year were valued from 7·25 to 8·20*d.* per pound and all the four native cottons were valued at 6·00*d.* per pound. On the same date the market value of good Tinnevelly was 7·00*d.* per pound, fine Broach was 7·1-16*d.* per pound; and middling American 8·00*d.* per pound. Fibre under ¾″ is not liked in Liverpool; therefore the native cottons have not been very highly valued.

An acclimatised American variety (No. 266 F.) valued at 7·10*d.* per pound was handed over to the Professor of Agriculture last year as an all round good cotton, and 11½ acres of this variety are now growing. Nos. 199 F. valued at 8·00*d.* per pound and 270 F. valued at 7·00*d.* per pound were handed over last year, and about 1½ acres of each are now growing. Of the native cottons, No. 29 valued at 6·00*d.* per pound was handed over last year, and variety No. 26 valued at 6·00*d.* per pound was handed over this year. Considering the extraordinary rapidity with which cottons multiply, these should soon make themselves felt in the trade of the province.

The collection of Punjab and North-West Frontier cottons has been run into several types. Herbarium specimens and lints have been sent to the Imperial Cotton Specialist for opinion.

Wheats.

8. About 12 acres of land were under wheats. The land was in fair condition and received no manure. About 200 varieties were under observation. Lal kale kasarwali (a good local variety) was grown as a standard at intervals over the whole area to check any unevenness of the quality of the land.

The Punjab classified wheats have been multiplied with all speed for trials on a field scale in different districts of the province. Seed should be available for extensive experiments this year.

About 60 plants were crossed; the idea is to increase, if possible, the nitrogen contents of the best yielding and milling varieties and to strengthen the straw, &c.

Jute. Corchorus capsularis.

9. Last year's work on jute has been practically confirmed. One sample of jute grown at Lyallpur was valued by the Indian Jute Co., Calcutta, at Rs. 6-12 per maund. This was the top price of the day. Several samples were valued at Rs. 6-8 per maund on the same date. Owing to the high price of labour the jute crop will have a poor chance of succeeding here until machinery is devised to extract the fibre. This is accentuated by the fact that practically only one batch of jute is retted before the temperature becomes too low for retting, and also that the farmers are busy at that season harvesting their Kharif crops and sowing the Rabi ones. Suggested experiments in Gurdaspur have been postponed till Mr. Milligan is transferred there, owing to the extreme care required to produce a successful crop.

San. Crotolaria juncea.

10. Experiments were carried on to show how *san* compares with jute as a profitable fibre crop for the Punjab.

Miscellaneous.

11. Experiments with barley, grams, maize, large millet, flax, groundnuts, Smyrna figs, and English melons were carried on.

Mycology.

12. An Assistant professor of Mycology has just been engaged, and has started work.

D. MILNE,
Ecconomic Botanist, Punjab.

13*th August*, 1910.

APPENDIX III.—(SEE PART IV.)

ANNUAL REPORT OF THE DEPUTY DIRECTOR OF AGRICULTURE, PUNJAB, FOR THE YEAR 1909-10.

1. My headquarters still continue to be at Lyallpur. During the year, I spent 107 days on tour visiting 11 districts.

Agricultural machinery.

2. Questions relating to tillage and farm machinery have occupied the greater part of my time and that of the staff working under me. A special area has been set aside at the Lyallpur Agricultural Station for experimental and demonstration work in this direction. It has been recognised for some years back that any real improvement in the agriculture of the Province generally and more especially of the canal colonies must be preceded by an improvement in tillage and other farm implements.

Harvesting machinery.

3. During the last three years, attempts to reduce the wheat harvesting season by the introduction of reapers and winnowers have met with a large measure of success in the case of the former and modified success in that of the latter.

Reapers.

(*i*). During the year under report, the popularity of reapers has increased considerably as shown by the increased sales, which have gone up from 42 in 1909 to 72 in 1910. These machines have been mostly taken up by people in Lyallpur District, but a few centres such as Kasur and Raewind have taken a fair share. Two satisfactory features deserve comment. In the first place, the new machines have mostly gone to the same or surrounding villages as those of the last year. In the second place, co-operative purchasing has increased considerably, the number of partners ranging from three to as many as ten. Similar arrangements for teaching and visiting, as were made last year, were carried out and proved satisfactory. The detailed results were similar to those of last year and need not be repeated. Generally speaking, with a few exceptions, the machines were well handled by their users and gave entire satisfaction, although many crops were lodged.

Winnowers.

(*ii*). As mentioned in last year's report, the winnower designed for dealing directly with the *bhusa* and grain mixture on the threshing floor was not an unqualified success owing to the coarse nature of the straw, which has been severely weathered before reaping time. The design has been entirely remodelled and a trial machine has given excellent results with both coarse and fine *bhusa*. We expect to be able to put a number on the market for next season.

Threshers.

(*iii*). There remains the question of threshing. The Department has not directly tackled the question of wheat threshing, it having been left in the hands of private engineering firms to produce a machine suitable to the Provincial conditions. Last year, a steam thresher was given an extended trial at Lyallpur but as was forecasted in our Annual Report, local conditions are all against expensive machinery. The final results confirmed the impression then formed that unless stacking comes into fashion there is little chance for a steam plant with the short season at present in vogue. Several trials conducted at Lyallpur at the end of the threshing season this year, however, lead us to hope that the high speed drum may be dispensed with and that a new and more economical way of making *bhusa* will yet be arrived at. If these ideas are confirmed by actual experience it may be possible to develop a moderately cheap and efficient bullock power machine, which if successful, would undoubtedly become popular.

Tillage implements.

4. Starting in 1908 with the definite object of improving the kharif crop cultivation in the colonies and more especially the improvement of the cotton crop, this side of our work has developed extensively. It is a well known fact that while the wheat crop in the Lyallpur District is on the whole fairly well done, the cotton and other kharif crops are not at all what they should be. This is largely due to the unnecessary prolongation of the wheat harvest season and the general accumulation of farm work at that time. Much of the cotton crop is put in after one or two ploughings with the *desi* plough, although it is generally known that land for cotton should have a deep, fine, and moist tilth.

Light furrow-turning plough.

(*i*). A light handy furrow-turning plough used at the Agricultural station last year showed the possibility of rapidly securing a suitable seed bed with one ploughing. A further improvement in the design of the implement has given even better results this year. The operations have been keenly followed by many people and, without any advertising, over 200 ploughs costing from Rs. 26-8-0 to Rs. 30 have been taken up. These implements have been found very useful in thoroughly ærating land, destroying perennial weeds, and in rapid cultivation. They have in several cases outside the station produced good results on grassy rice land, the effect in one case being described as like that of a heavy manuring, while, for gram and wheat I have seen several excellent results.

Harrows.

(*ii*). The rapid ploughing up of land after wheat, after occasional showers in June especially, is recognised as being very beneficial to succeeding crops. Spring toothed harrows have been found very useful for this purpose. A specially designed implement for ordinary bullocks capable of dealing with 4 *killas* (4½ acres) per day has met with a fairly large sale, thirty-eight having been disposed of since January 1st, 1910. These harrows are useful for all sorts of tillage work and can be used to replace the *khurpi* (trowel) in the after cultivation of the sugarcane crop, saving 90 per cent. of the labour involved. In addition, trials at Lyallpur seem to indicate that by their use the tillering of the cane crop is very largely increased.

Demonstrations of machinery working.

5. A large number of working exhibitions of all the machines and implements found useful at Lyallpur, have been undertaken throughout the year. During the Lahore Industrial Exhibition, demonstrations were given daily. Exhibitions were given at the Ambala, Lyallpur, Sargodha and Gujrat Fairs, while monthly training classes were held at Lyallpur. A few outside demonstrations at the suggestion of private individuals were undertaken with good results.

American cotton.

6. The area under American cotton sown from seed supplied by us during the year amounted to 423 *killas* in the Lyallpur District and 631 in the Jhelum colony, as compared with 142 and 445 in the previous year. The increase of 467 *killas* does not, however, represent the total increase in area as there is a growing tendency on the part of users to grow their own seed. The crop in both colonies was slightly below average and barely came up to the yield of the *desi* plant.

Auctions of American cotton.

7. The produce was mostly disposed of by auction. Two sales, each at Lyallpur, Sargodha and Bhalwal were arranged for in December and January. The greater part of the *capas* was disposed of at the December sales at Rs. 8-8-0 and Rs. 8-5-0 at Lyallpur and Sargodha, respectively. During the rise in prices in December the remainder of the produce was sold privately. The prices attained at the auctions were Rs. 1-8-0 and Rs. 1-6-0 above the average *desi* prices of the same days in the local markets. Owing to the great fluctuations in the price of *kapas* during the season, it is difficult to say if the growers really benefited much through growing this crop in place of *desi* cotton as the people who held up till the end of December got very high prices for *desi kapas*. As a matter of fact it is probable that the balance was in favour of the *desi* article as sales of seed for this season show a slight falling off from last year's. The old question of marketing small quantities of a new staple is thus just as acute as ever. In order to create competition the produce has to be collected and arrangements have to be made for sales on definite dates which in a fluctuating market may or may not be suitable for securing good prices. For a well established staple like *desi kapas* no such difficulty is felt as the seller can either take the market rate, if it is suitable, or consign his produce to a broker. I am still of the opinion that the disposal of the American cotton cannot be safely and satisfactorily undertaken without capital and possibly without storage accommodation. It was not until I had secured an offer of Rs. 30,000 from a private firm to finance the marketing in case of a break down in price that I could safely arrange for the auctions last year.

Hadi's sugar plant.

8. This plant has been abandoned by the Department as not being suitable for the Province.

Chrome leather *charsas*.

9. A number of *charsas* made from chrome leather have been tried in the Jullundur District. It is claimed that leather tanned by this process lasts better in water than the ordinary leather of the country. The results up to date have been somewhat conflicting. In some cases, the *charsas* have shown no better lasting properties than the *desi* article, while in others they have done very well.

Castor cake.

10. A free distribution of castor cake was made in the Jullundur, Amritsar, Hoshiarpur and Gurdaspur Districts. The manure has been found useful as a substitute for and a supplement to farmyard manure. There is a large enough market in the Province for all the castor cake produced here and it is hoped that it will find its way into the fields of the Punjabi cultivator instead of going to Bombay.

Advice to selected Court of Wards' estates.

11. Under Government orders I have visited two Court of Wards' Estates, *viz.*, Mamdot and Kot Fateh Khan.

Mamdot.

(*i*). At Mamdot, the chief agricultural problem is the eradication of weed grasses, which threaten to totally overrun the lower lying land on the Estate. Thorough eradication by ploughing has been proved to my satisfaction to be feasible, but the work would probably have to be undertaken by the Estate owing to the fecklessness of the Estate tenants. The question of the Estate undertaking the work by employing steam power is still under consideration.

Kot Fateh Khan.

(*ii*). The Kot Estate was visited in May and my recommendations are, I believe, being carried out. The chief recommendations were :—

(*a*). The extension of the '*banding*' of streams.

(*b*). Attempts to diminish surface drainage by deeper ploughing and cultivation as soon after the wheat harvest as possible.

(*c*). Trial of gram with deeper tillage.

(*d*). The improvement of seed distribution which is at present largely in the hands of the estate.

Lahore Exhibition.

12. Under orders of Government I gave some assistance at the Lahore Industrial and Agricultural Exhibition and arranged a collection of Indian farm implements. Owing to the want of sufficient previous notice this section was not nearly so good as it might have been.

Well-boring.

13. The well-boring scheme for making trial borings, tubing wells and generally improving their water supply has been inaugurated. The necessary supervising staff has been trained at Cawnpore and eleven sets of boring apparatus have been purchased. We are now ready to start work. The districts of Rohtak, Karnal, Hoshiarpur and Gurdaspur have been selected for the first operations.

Reh.

14. The preliminary analytical investigations on this question are in the hands of the Agricultural Chemist. It is hoped that experimental work will be started shortly.

Eastern Punjab Agricultural Station.

15. The original site for this station at Jullundur has been abandoned and a new site at Gurdaspur has been selected and approved of by Government. The land belongs mostly to Government and, in addition, the existence of accommodation for offices, etc., will save a large capital outlay. It is hoped to have the land nearly all laid out during the coming year.

Staff.

16. The staff is still largely under training but I am glad to report that satisfactory progress has been made by most of the members. B. Sundar Singh, Assistant Director of Agriculture, Punjab, joined in June, 1910, after completing his training at Pusa and has been given charge of part of the current work of the section.

S. MILLIGAN,
Deputy Director of Agriculture, Punjab.

APPENDIX IV.

ANNUAL REPORT OF THE PROFESSOR OF AGRICULTURE, PUNJAB, FOR THE YEAR 1909-1910.

Introductory.

1. Mr. Roberts being on leave, the writing of his Annual Report has devolved on me. Mr. Roberts has in addition to his duties as Professor of Agriculture in the Punjab Agricultural College, held charge of the Lyallpur Agricultural Station. Reports on both sections of his duties are submitted separately. The following points not specially noted in the foregoing are submitted for report.

Tours.

2. Mr. Roberts joined his present appointment in September, 1909. Although busily engaged in the College he has found time to pay short visits to many of the districts in the northern and central Punjab.

Staff.

3. Bhai Kharak Singh entered upon his duties as Assistant Professor of Agriculture, in September, 1909. M. Mukhtar Nabi has been appointed Laboratory Assistant on probation. The office staff has been increased by the addition of another clerk mainly for farm work.

The Machinery Depôt.

4. The Departmental Machinery Depôt continues to be run by the Professor of Agriculture. The capital involved is Rs. 4,000, in the shape of a permanent advance by Government. The total turnover was, for the year, Rs. 9,312-13-11. A profit of Rs. 657 exclusive of charges for management and clerical work was credited to Government.

No attempt is made to compete with private firms, the policy being to assist in pioneering improved implements. The supplying of ploughs, reapers and harrows has already been entirely taken over by private firms.

Profit and loss account of the Depôt.

5. Profit and Loss Account of the Punjab Machinery Depôt, up to 31st March, 1910.

	Rs.	a.	p.		Rs.	a.	p.
Value of articles purchased ...	9,312	13	11	Value of machines sold excluding advances, Rs. 104	9,373	11	0
				Value of stock in hand at the end of March, 1910	457	11	9
Profit	657	8	10	Do. machines sold for which money has not been received in full up to 31st March 1910	139	0	0
Total ...	9,970	6	9	Total	9,970	6	9

Total sum in hand on 31st March, 1910 ... ... Rs. 651-1-0

Portion of this represented by advances for machinery ordered *nil.*

Details of sales.

6. Detail of machinery bought and sold during the year and balance in stock on 31st March, 1910.

Name.	No. bought.	No. sold.	Balance.
Diamond Ploughs	49	42	7
Winnowers	20	19	1
Chaff Cutters	9	8	1
Hand Hoes	2	2	*Nil.*
Horse Hoes	22	21	1
Universal Cultivator	1	1	*Nil.*
Maize shellers	2	2	*Nil.*
Meston Ploughs	10	3	7
Share cutters	12	*Nil.*	12

Lahore Exhibition.

7. Mr. Roberts arranged the poultry and incubator sections at the Lahore Exhibition.

Students' farm.

8. It has been found necessary to increase the size of the students' farm to accommodate the second year students. A further increase will probably be required next year.

S. MILLIGAN,
Offg. Professor of Agriculture,
P. A. C., Lyallpur.

APPENDIX V.

REPORT ON THE WORK OF THE ECONOMIC BOTANIST, OUTSIDE THE LYALLPUR AGRICULTURAL STATION, FOR THE YEAR 1909-10.

Tours.

1. Multan, Muzaffargarh, Dera Ghazi Khan and Jhang were visited regarding the date palm scheme. Various centres of silk rearing were also visited in the Gurdaspur district.

Lahore Industrial and Agricultural Exhibition.

2. The Lahore Exhibition and matters connected with it have taken up the greater part of my time and that of my assistants during the year; the "Crop Products", "Mycological", and "Entomological" sections of that Exhibition being got up and conducted by us. The Agricultural Department being very new, the Biological section had neither a previous collection of exhibits nor a trained staff sufficient for more than its most pressing needs, and had to overcome difficulties of very short notice, &c. Despite those drawbacks, however, a fairly complete and instructive set of exhibits was displayed, and the staff had the satisfaction of hearing many commercial and other visitors to the Exhibition speak most highly of the sections while the members of the Press were also unanimously laudatory. My most grateful thanks for assistance are due to my staff and to a large number of contributors whose names were submitted in a special report on the Exhibition forwarded to the Director of Agriculture, Punjab.

Date palms.

3. A scheme for improving and extending date cultivation in the Province has been drawn up. Enquiries were started last summer regarding the qualities of dates grown at present, the number of shoots from good female trees available for transplanting, &c., &c. The services of an experienced working date-grower from Arabia have been engaged for three years. This man will begin his work in September next. Areas of land at Multan and Muzaffargarh have been secured for model plantations. Offshoots of several of the best varieties of Arabian date palms have been ordered from Arabia. From enquiries made last season, it seems certain that a very material benefit will be conferred on the Province by attention to date growing. The appointment of a mali has been sanctioned to assist the date-grower from Arabia, and learn his methods.

Tapioca or Cassava plant. (Manihot Utilissima).

4. Cuttings of both sweet and bitter varieties of tapioca from Titabar, Pusa, Travancore, Eastern Bengal and Assam, and Brisbane were received and planted at Ambala, Dharuhera (Gurgaon District), Pathankot, and Lyallpur in early March, 1909. The crops were harvested in December of that year. Plots receiving no water at all were put down at Ambala, Dharuhera and Pathankot to test whether the extraordinary claims regarding drought resistance sometimes made for the crop are justified. A second set of plots put down at Ambala and Dharuhera received one watering at the time of planting only. This was intended to show whether a moist seed bed in early April would be sufficient to produce a crop. A third set of plots was put down at all the four stations, and received an ordinary supply of water to show whether cassavas would grow at these stations in ordinary conditions. The soil of the first set of plots at Ambala and Dharuhera was very dry and the plants totally failed as was expected. At Pathankot, the soil was moist enough for any ordinary crop when the sets were planted, and these gave an estimated outturn of about 10,000 pounds of fresh roots per acre of plants actually harvested. In the second set of plots, that at Ambala failed while at Dharuhera a crop of 3,189 pounds was produced. In the third series of plots the crops were as follows:—

Lyallpur ...	10,500 pounds of fresh roots approx. per acre.			
Pathankot ...	9,000	do.	do.	do.
Dharuhera ...	4,700	do.	do.	do.
Ambala ...	2,240	do.	do.	do.

In Travancore, according to information received, an average crop of fresh roots is 20,000 lbs. per acre and fetches about Rs. 140. At all the stations and in all the plots the plants appeared in robust health and there was practically no difference in their height; all being about 8 ft. high. White-ants attacked both the sweet and bitter varieties viciously between the time the sets were planted and the time they became firmly established. As a protection the sets were dipped in sanitary fluid before being planted, or had the earth around them well mixed with wood ashes. Very great damage was caused in spite of these precautions. If planted without any special treatment, practically the whole crop would apparently be destroyed by white-ants within a few days of its being put into the ground.

Miscellaneous.

5. Enquiries have been made and some work started on the tobacco and potato crops of the Province. Many varieties of maize, gram and other crops have been collected from other Provinces of India and abroad and are being grown at Lyallpur. Provincial and other enquiries have been dealt with.

D. MILNE,
Economic Botanist, Punjab.

13th August, 1910.

APPENDIX VI.—(See Part V.)

REPORT ON THE ENTOMOLOGICAL WORK DONE DURING THE YEAR 1909-10.

The Entomological section has been under me during the year. Mr. Carson the Assistant Professor of Entomology having had as free a hand as possible in dealing with the work, a report by him is attached. In connection with silk rearing, about 798 cuttings of the Philippine variety of mulberry were procured by the Director of Agriculture, and are now growing well here. Experiments with the coppice or bush system of growing mulberries, and the pruning of plants to produce early leaves are being carried on.

D. MILNE,
Economic Botanist, Punjab.

REPORT BY Mr. CARSON, ASSISTANT PROFESSOR OF ENTOMOLOGY.

Staff.

1. The assistant professor joined the section in June, 1909. The staff then consisted of the assistant professer and one agricultural assistant. In February, 1910, proposals were put forward for an increased staff. The staff now consists of the assistant professor, one agricultural assistant, one mukaddam, one setter and rearer, one laboratory attendant and four fieldmen.

Training.

2. The training of the staff has taken some time; they are being trained to work on systematic lines and it is hoped that very soon the section will be equipped with a well-trained and efficient staff.

Touring.

3. The assistant professor spent 173 days on tour during the season under report.

Pests.

4. The insect attacks dealt with included—The rice bug, *leptocorisa varicornis*, on rice; the rice grasshopper, *hieroglyphus furcifer*, on rice; surface grasshoppers, *epacromia dorsalis*, and *chrytogonus trachypterus*, on jowar, maize, sugarcane, etc.; the moth-borer, *chilo simplex*, on maize, jowar and cane; the jute caterpillar, *caradrina exigua*, on jute; the cotton boll-worms, *earias fabia*, and *earias insulana*. Little or no damage was done by these pests in the Province, except in the case of the rice bug.

In most cases reports of damage arrived too late to enable remedial measures being succesfully adopted. In several places, however, bagging was demonstrated. The use of lead arseniate as a poison against caterpillars proved entirely successful in all cases, especially against the jute caterpillar.

Sericulture.

5. Khan Bahadur, Shaikh Ghulam Sadiq, Honorary Magistrate, Amritsar, obtained 200 ounces of disease-free eggs from France through the Director of Agriculture, Punjab. This seed he distributed in the Gurdaspur district. The Director of Agriculture lent the services of a trained man to advise the rearers. The results in most cases were unsatisfactory due probably to late incubation and want of sufficient care on the part of the rearers.

In Lyallpur itself several varieties were reared with a view to ascertaining what the results would be under certain conditions and with certain varieties of mulberry leaf. The Lyallpur results were satisfactory. At present, it is not possible to say what the quality of silk is like as the cocoons have not yet been sent to a filature.

Bee-keeping.

6. Bee-keeping in Simla was revived. An association was formed which is progressing favourably.

Exhibition.

7. The section was represented at the Punjab Agricultural and Industrial Exhibition. Life histories of 78 Indian insects were shown, also cases containing lac, bees, and silk, were exhibited. The complete life history of the silk-worm was shown in detail from the egg to the spinning.

Field entomological work.

8. Owing to the Exhibition this was not really taken in hand till February and even then had to be somewhat neglected owing to the setting of the course in the College and arranging for teaching.

G. M. CARSON,
Assistant Professor of Entomology.

APPENDIX VII.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST, PUNJAB, FOR THE YEAR ENDING JULY 31st, 1910.

General.

1. During the year 1909-10 the time of the Agricultural Chemist has been almost entirely taken up with the teaching of Chemistry and Physics in the first year's course in the Punjab Agricultural College, and with the administrative duties connected with the Principalship of the College.

Staff.

2. The absence of staff in the laboratory of the Agricultural Chemist has stopped all provincial work with the exception of consultation and advice. Some difficulty too has been experienced on account of unavoidable changes in the assistant teaching staff which occurred during the session.

Provincial work.

3. The analysis of Reh soils has been pushed on during the College vacations and we await the appointment and training of an analytical staff to commence field operations on the reclamation of salt-infected land. It has been found impossible to carry out the proposed programme of work in Agricultural Chemistry during the year on account of my inability to secure assistants on the sanctioned scale of pay. The correspondence of the section is growing and advice is solicited from other Government departments and from private individuals. We are not yet in a position to undertake work involving laboratory investigation or analysis but advice is given wherever possible. The paucity of staff on both sides of the section is seriously hampering progress and an undue amount of detail work has consequently to be borne by the Agricultural Chemist himself, but, apart from this, the progress of the section has been satisfactory and offers great opportunities for expansion.

J. H. BARNES,
Agricultural Chemist, Punjab.

1910/11.

REPORT

ON THE

OPERATIONS OF THE DEPARTMENT

OF

AGRICULTURE,

PUNJAB,

For the year ending the 30th June, 1911.

Price: Re. 0-7-0 or 7d.

Lahore:
PRINTED AT THE PUNJAB GOVERNMENT PRESS,
1911.

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REPORT

ON THE

OPERATIONS OF THE DEPARTMENT

OF

AGRICULTURE,

PUNJAB,

For the year ending the 30th June, 1911.

Lahore:
PRINTED AT THE PUNJAB GOVERNMENT PRESS,
1911.

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Proceedings of His Honour the Lieutenant-Governor of the Punjab in the Department of Revenue and Agriculture (Agriculture), No. 153, dated 1st November 1911.

READ—

Letter No. 523 S., dated 6th October 1911, from the Senior Secretary to the Financial Commissioners, Punjab, forwarding, with the comments of the 2nd Financial Commissioner, the Annual Report on the Department of Agriculture in the Punjab, for the year ending 30th June 1911.

REMARKS.—The period under review has not been marked by any new departure, either in the organisation of the agricultural department or the scope of its activities. The new agricultural station at Gurdaspur, which was opened last year, has taken almost all the Deputy Director's time and attention, and valuable results should be obtained there in due course. The pay and prospects of the agricultural staff have been improved and the cadres increased in various directions. The Director regrets the lack of staff, but the Lieutenant-Governor would remind him that it is necessary to move slowly, and His Honour must insist on the careful observance of the condition once laid down by the Government of India and frequently reiterated by this Government, that no sanctioned post should be filled up unless there is a man really qualified to fill it.

2. The Punjab Agricultural College is now in the third year of its existence. There are 30 students in their first year and 35 are pursuing the second or third year's course. The report of the Principal shows that the senior students are making great progress, both in technical and scientific attainments. The readiness of the students to work with their own hands on the farm is very satisfactory, and indicates a real desire to acquire a practical working knowledge of scientific agriculture. The Director is inclined to emphasise the unpopularity of the College. Sir Louis Dane places little value on the popularity of an institution, which after all is not the sole measure of its success, and entirely agrees with the Financial Commissioner that it is all important at the outset to get young men of the right stamp.

3. The apathy of district officers is a more serious matter, and His Honour regrets to notice that this apathy is apparent, not only as regards the College, but in relation to the experimental work of the agricultural department. This is not the first occasion on which the apathy of some District Officers in regard to matters vitally important to their charges has been brought to the notice of the Lieutenant-Governor, but it is obvious that a Collector who is not interested in the main industry of his charge is entirely unfit for his position. No doubt the Financial Commissioners will take measures to bring home to Deputy Commissioners the importance and the prospective usefulness of the agricultural department and will induce them to take more pains to spread among the agricultural classes information relative to the agricultural college.

4. Now that the province has two well-equipped agricultural stations, more definite results may be expected from experiments. Sir Louis Dane would be glad to know what is being done about the equipment of the Delhi Station in connection with the Reformatory and Sullage Farms, which appears to offer a most excellent opportunity of solving many interesting agricultural questions. The classification of wheat is still going on, and His Honour can well believe that it will be some years before the many different wheats of the Punjab are correctly classified. The Financial Commissioner is undoubtedly right in deprecating Mr. Hamilton's suggestion to establish a number of small local farms. Our main object should be at present, as Mr. Hamilton admits, to find out what kinds of wheat give the greatest average yield over a series of years. Purity from admixture and the use of fresh seed are means subsidiary to the main end, which is not so much an accurate tabulation of wheats, as the betterment of the staple in order that the wheat-grower may make a larger profit.

5. The cotton experiments are perhaps more productive. The reduction of the Dharwar American cottons to six, which are being tried on larger areas, before being recommended to cultivators, is a definite advance, and His Honour wishes to acknowledge the patience and perseverance which have enabled Mr. Milne to obtain such a definite result.

The experiments with Nitrate of Lime are interesting and important. If large electrical works are started in the Punjab it should be possible to manufacture this valuable fertiliser at a cost which will bring it well within the means of the peasant farmers.

Minor experiments show that cassava will not grow in the Punjab and that improvements are possible in the potato crop in the hills. The dates from Arabia promise well, and it is hoped that Punjab rubber from the *cryptostegia grandiflora* may some day be quoted on the market. The plant grows freely in all parts of the province and the reproduction where it is once established is very rapid. The quality of the rubber produced is good.

6. Mr. Milligan has been busy at Gurdaspur and has had less time than usual for demonstrations with machinery. It is encouraging, however, that an English firm with the reputation of Messrs. Ransomes of Ipswich should think it worth their while to send out an expert to Lyallpur.

7. The Agricultural Chemist has now submitted to the Director a report on soil alkali which His Honour awaits with interest. The abstract of his conclusions, given by Mr. Barnes, does not suggest that any great advance has been made towards the solution of the problem. Well-boring experiments are giving useful results in some parts of the province.

8. On the whole, despite some failures, the year's work has been useful and the Lieutenant-Governor would acknowledge the vigour and enthusiasm with which the agricultural experts pursue their experiments in the face of novel conditions and many difficulties.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for information, that they be published in the *Punjab Gazette*, and submitted to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor, Punjab,

H. P. TOLLINTON,

Revenue Secretary to Government, Punjab.

Punjab Government Press, Lahore—4-11-11—1516—512—C D.

No. 523 S.

FROM

A. M. STOW, ESQUIRE, I.C.S.,
Senior Secretary to the Financial Commissioners,
Punjab,

To

THE HON'BLE MR. H. P. TOLLINTON, I.C.S.,
Revenue Secretary to Government, Punjab.

Dated Simla, 6th October 1911.

The Hon'ble Mr. A. MEREDITH.

SIR,

I AM directed to submit the annual report on the operations of the Department of Agriculture, Punjab, for the year ending the 30th June 1911, together with a separate note containing the comments of the 2nd Financial Commissioner, Punjab.

I have, &c.,
A. M. STOW,
Senior Secy. to the Finl. Commrs., Punjab.

P. G. B. Press, Simla—6-10-11—No. 1 F. C.—450.

Note dated 3rd October 1911, by the Hon'ble Mr. A. Meredith, Officiating 2nd Financial Commissioner, Punjab, on the annual report of the Department of Agriculture, Punjab, for the year ending 30th June 1911.

Form of the Report.

The Director's report is prepared in accordance with the recent orders of the Government of India. No separate report on Agricultural Stations has been prepared, but the Director forwards *in extenso* seven appendices written by the experts connected with the Agricultural College at Lyallpur, and the Agricultural Stations at Lyallpur and Gurdaspur.

The College.

2. The Director dwells on the paucity of students, and concludes that the College is not popular with any class. It could hardly be popular with the classes for whom Government has declared that the College is not primarily intended, while as regards the agricultural classes there would appear to be some justification for the remarks of the officiating Principal that district officers, through whom alone the interest of landholders can be aroused, are apt to show themselves indifferent. It is however more important that students, though few, should be of the right agricultural stamp than that the class rooms should be filled with town-bred place-hunters. The report of the officiating Principal shows that the students have made considerable progress, and it is satisfactory to note that the men evince no desire whatever to shirk the manual labour involved by practical work.

Co-operation with District Officers.

3. The tone of the Director's report is somewhat pessimistic as to the results achieved in the Agricultural Stations. He points out that the staff is still very much below the sanctioned scale, and the work which can be undertaken outside Lyallpur and Gurdaspur very small. It may be true, as the Director remarks, that few zemindars know of the existence of the Agricultural Department and district officers neither ask for or obtain assistance. The remedy for this is to bring district officers and cultivators in closer touch with the Department, and the Financial Commissioner is glad to note that Mr. Hamilton is directing his attention to this most desirable end.

Value of Agricultural Stations.

4. The Director casts doubt on the value of the experimental wheat and cotton growing in Lyallpur and Gurdaspur as a guide for the rest of the Province, and remarks that the soils of these stations do not offer a good field in which to test manures. He would aim at establishing a number of small local farms in which the local wheats would be grown and improved by cross fertilization. The lack of duly qualified assistants precludes the adoption of this course for some time to come, and in any case the Financial Commissioner doubts whether such a scheme would be as useful as Mr. Hamilton thinks. In many districts soils vary almost from village to village, and the local farms, judged by the standards which Mr. Hamilton would apply, might be found no more valuable than the Lyallpur and Gurdaspur Stations.

The year's work at the Lyallpur Station.

5. In the Financial Commissioner's opinion the year's work described by the Professor of Agriculture, the Economic Botanist and the Agricultural Chemist is of a valuable nature. The results of many experiments are, as might be expected, negative, but the labour-saving qualities of the furrow-turning plough and the success of green manuring with hemp should be noted. A preliminary investigation of alkali infected soils has been completed. The conclusion of the Agricultural Chemist that adequate drainage must accompany canal irrigation and his warning against the effects of over-irrigation in the Chenab Colony should not be disregarded in the anxiety to extend the canal system in all directions. The wheats of several districts were analyzed and classified, but much remains to be done before conclusive results are attained.

Samples of gur, oats and manure were analysed and further investigations are promised. In addition to the work done at Lyallpur the Economic Botanist conducted some successful experiments with the best varieties of Scotch and Italian potatoes in the Simla and Kangra districts. The improvement of this valuable crop is of great importance, affecting not only the prosperity of the hill population, but also the traffic returns of the Simla-Kalka Railway.

The Deputy Director's work.

6. Mr. Milligan has been fully occupied with the creation of the Agricultural Station at Gurdaspur. But it is evident that the all-important demonstrations of agricultural machinery have not been neglected. So far as the smallness of the staff has permitted, this branch of the department's work has been energetically pushed on. A good beginning has been made with well-boring experiments, and the success obtained in the Rohtak District in obtaining considerable supplies of underground water at lower depths than are at present tapped by the ordinary wells should be noticed.

The staff.

7. In spite of the comparative failures in sericulture and poultry farming the Financial Commissioner considers that the staff of the Agricultural Department have done their best to contend with the difficulties of a small staff and the apathy of district officers, and are to be congratulated on progress which is not less sound because results may be slow in making their appearance.

P. G. B. Press Simla—6-10-11—No. 1 F. C.—450.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30th JUNE 1911.

Administration.

1. Mr. Renouf was Director of Agriculture up to 18th March, when I took over charge. The changes in the staff are few. Mr. Carson, Assistant Professor of Entomology, resigned in September: his successor, Lala Madan Mohan Lal, is still under training at Pusa. Mr. Mitter took up his duties as Assistant Professor of Mycology on 31st May 1910, but I do not think we need a Mycologist in the Punjab. Our only Assistant Director of Agriculture has been dismissed since the close of the year for bringing a false charge against his superior officer: he would in any case probably have been removed later on for incompetence. Our cadre originally included two Assistant Directors, and the second man, M. Fateh-ud-din, who was under training, has recently joined.

The scheme for improving the pay of the subordinate staff mentioned in last year's report has been sanctioned since the close of the year. This staff is still very much below the sanctioned scale, and the work which can be undertaken outside Lyallpur and Gurdaspur is small.

The College.

2. Appendix I gives the history of the College. It was ceremonially opened by the Lieutenant-Governor on 14th December. The third session has now begun and there ought to be 3 × 38 students in residence. Actually there are only 35 of the first two years and 30 new students, or 65 altogether. Of the 8 selected scholars for this year only one has come into residence, and from the 81 applicants for admission only 29 students have been obtained. Most of the new men have no object except to win an educational qualification which will secure them service under Government. The College is not popular with the classes we wish to attract, nor indeed with any class. It will not become more popular, until either the educated members of the agricultural classes begin to place an independent career above Government service, or Government holds out special prospects to those who obtain the diploma of L. Ag. By offering the latter temptation we could fill the College, but we should petrify its spirit.

Research and experiment: general agricultural—

3. The Professor of Agriculture gives the general conclusions and deductions from the working of the Lyallpur Farm as follows:—

(1) Sub-soiling has proved beneficial in case of sugarcane for the first time since the experiment was started 3 years ago.

(2) Nitrates either in the form of $Ca(NO_3)_2$ or of Nitre apparently have little or no residual effect in the succeeding season.

(3) $Ca(NO_3)_2$, although almost invariably giving an increased yield has not yet proved profitable.

(4) There appears to be no advantage in sowing cotton on ridges in good land.

(5) In the comparison of the furrow turning and *desi* plough the results show that less labour is required to get the land into proper condition by means of the former than with the latter.

(6) Green manuring with *san* (hemp) has proved very beneficial in regenerating light soil.

Research and experiment : wheat.

4. All the Punjab types[*] of wheat and many others have been grown in Lyallpur and Gurdaspur. Wheat of types 9 and 11 has done best in the field at Lyallpur, and No. 9 was regarded as the best Punjab wheat by the English miller who carried through the tests of the milling and baking qualities of Indian wheats. No. 9 has also given a very heavy yield in Peshawar. These are both bearded wheats, the former red and the latter amber grained. But the fact that a wheat does well in Lyallpur does not prove that it will give a large yield elsewhere and be resistant to drought and rust. It is well known that the character of wheat changes very greatly according to the environment, and in a weak wheat country most strong wheats quickly deteriorate into weak wheats. So it is not likely that we shall be able to improve the wheats of the Punjab by growing them in Lyallpur and Gurdaspur and then transplanting them back to their local habitats. We must grow selected seed in the local home of the wheat and give it there the best cultivation possible. To this end we need firstly to have a knowledge of what wheats are grown in each district, and secondly we must have a number of small local farms—land on cash rent would do quite well—where to grow them and to improve them by cross fertilization. Accordingly last April I had a survey of the wheats of the Gurdaspur and Montgomery districts carried out. The results shew the following to be the predominant wheats ;—

Gurdaspur district.

Tahsil Gurdaspur—types 13, 14, 10, 12, 16, 17.
,, Batala—types 13, 14, 16, 10, 12, 1, 2.
,, Shakargarh—types 14, 13, 17, 20.
,, Pathankot—types 17, 20, 13, 14, 23, 24.

(The first named wheat is in each case much the commonest.)

Montgomery district.

Tahsil Montgomery—types 10, 11, A, 17, 18, 14, 15, 9.
,, Gugera—types 10, 11, 9, A, 14, 15, 17, 18.
,, Dipalpur—types 16, 17, 18, A, B.
,, Pakpattan—types 24, 10, 11, 9, 14, 15, 17, 18, A, B.

(Wheats much more varied or mixed than in Gurdaspur : A and B appear to be new types.)

If there are enough agricultural assistants available, the survey of several other districts will be undertaken next spring.

As to the farms it is difficult to do much until we get a larger staff of agricultural Assistants.

I should like to quote certain authorities as to wheat.

"The grower is not directly interested in the intrinsic value of the various wheats ; his object is simply to produce the wheat that gives him the highest profit per acre."[†] "The strong wheats of the world are at present cultivated almost exclusively in countries in which the yield per acre is small. Where large yields are the rule the weaker types only are in general cultivation."[‡] Whether a combination of strength with heavy yield is possible or not is still undecided.

There is at present a demand for strong wheats in England, and Mr. Howard holds that to grow strong wheat is *the* object. Up-to-date millers can, however, by chemical means make weak flours act as strong, and the question whether or not this should be legal is a burning question. Exporting firms in the Punjab say grow white wheat, no matter whether it is strong or weak, and they pay 2 annas a maund more for white wheat. Common sense says grow the wheat in each tract which gives the greatest outturn through a series of good and bad years—that is, which is heavy yielding, and rust and drought resisting; for one maund extra means Rs. 2-8-0 or Rs. 3 more and with a ten maund crop it would need a difference of 4 annas a maund between the prices of strong and weak or of white and red to give Rs. 2-8-0 extra, and such a difference is not probable with the present trade customs [*] If we are to help the zamindars at all we must do all we can to give them pure seed of the locally most productive wheat, and afterwards, if we can, introduce by hybridization the other desirable qualities—strength or whiteness or whatever may be the fashion of the time. A heavy yield unmixed with barley, not strength nor whiteness, is what all our energies should be spent on attaining.

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[*] For the types see "Wheat in India" by Howard, page 173, &c.

[†] Introduction in Appendix A to the Report of the proceedings of the British Association at Winnipeg.

[‡] Ditto ditto ditto ditto Paper by Prof. R. H. Biffen.

Research and experiment: cotton.

5. It will be noticed that the report of the Economic Botanist regarding cottons (Appendix III) deals largely with varieties, while the Professor of Agriculture (Appendix II) treats chiefly of cultivation and the Deputy Director of Agriculture (Appendix VI) prefers the commercial side of cotton-growing. This is due to differences of outlook. I have not had much opportunity yet of taking up the cotton question, but apparently it still remains true that in the Punjab the shorter the staple and the coarser the cotton the more profitable it is. Statements IV, VIII, IX and A shew that by good cultivation very heavy crops of cotton, both indigenous and American, can be obtained. Heavy yields rather than long staple will attract the cultivator, at least until there is a separate market for long staple cotton at distinctly higher prices. Accordingly a good deal of attention is being given to the demonstration of cotton cultivation. This year the American cotton is said to have suffered much less than the indigenous from boll-worm.

Research and experiment: manures.

6. The report of the Professor of Agriculture shows that, except as regards green manuring, the manurial experiments have given few definite results. The comparatively rich and homogenous soils of Lyallpur and Gurdaspur do not offer a good field in which to test manures. For them too I am sure we must have small local farms scattered over the province, where there are distinct and definite deficiencies in the soils to be supplemented.

I hope green manuring will become popular in canal tracts. The Canal Department have agreed to charge no water rates on the Lower Chenab Canal on *san* (hemp) and indigo grown for green manuring and ploughed into the land before September 15th. An Urdu leaflet drawn up by Mr. Milligan, in which brief instructions are given, has been distributed in the districts irrigated by the canal.

Chemical and Botanical research and experiment.

7. The facts are given in Appendixes III and V, and I have no remarks to make.

Research: Entomology and Mycology.

8. In Entomology and Mycology there has been little or no research or experiment. Since the close of the year grasshoppers and boll-worms have given plenty of practical experience, but we have no Entomologist of our own to make the best use of it. We have borrowed an Entomologist from Pusa and he is now studying boll-worms and their parasites in Lyallpur.

Sericulture.

9. Last February 379 ounces of silk-worm seed were distributed to growers. The chief takers were—

	Ounces.
Khan Bahadur Sheikh Ghulam Sadik of Amritsar for zamindars of the Gurdaspur district	275
The Salvation Army for rearing at Changa Manga	25
Sardar Hari Singh of Wahali	25
Settlement Officer, Ludhiana	5
Nahan State	2
Patiala State	3
Various Canal Officers	8
Lala Ganeshi Lal, Hathur	2

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[*] Besides only about one-fourth of the wheat grown is exported and a large proportion of the rest the farmer eats himself. He prefers bulk to gluten.

One ounce was reared by the Director of Agriculture at Lyallpur. This experiment at Lyallpur was entirely successful and the results may be taken as a standard:—

Hatched.	*Dates of hatching.*	*Cocoons.*		*Dry cocoons sold to Messrs. Anderson and Wright, Calcutta, for*
		Green.	*Dry.*	Rs. A. P.
1 *Oz.*	25th February to 7th March	44½ sers	16 sers 1 ch.	48 10 0

There were between 1,500 and 1,600 dry cocoons per ser for the different varieties of seed.

Sheikh Ghulam Sadik got only 33 maunds 16 sers of dry cocoons, whereas he might have hoped for 110 maunds. The Salvation Army's worms were drowned out at Changa Manga and disease wrought havoc. Other results so far as they have been reported were—

	Hatched.	*Cocoons.*		
		Green.	*Dry.*	
	Ounces.	Srs.	Srs.	
Salvation Army	...	300	...	
Settlement Officer, Ludhiana ...	5	...	17½	
Nahan State ...	2	66	46	(The cocoons cannot have been quite dry.)
Canal Officers ...	7	260	89	
Lala Ganeshi Lal	2	69	43	(The cocoons cannot have been quite dry.)

The Punjab zamindar is probably too well off to take kindly to the raising of worms—an occupation which many regard as fit for menials only. Moreover, to find room for the worms from even one ounce of seed—the books prescribe 300 square feet—taxes the house accommodation of most zamindars. The chief lesson of the year is that one ounce of seed is the maximum amount which any one family should rear: the failure in Gurdaspur was largely due to rearers undertaking too much seed.

From one ounce of seed a return of Rs. 48 can be obtained by out of pocket expenditure of perhaps Rs. 5. The collection of leaves is troublesome, but the poorer cultivators with a number of idle boys and girls ought not to mind that.

Sheikh Ghulam Sadik has started a filature in Amritsar which should be a great convenience to growers. His price was Rs. 2-4-0 a ser for dry cocoons. This is less than I got in Calcutta; but it has to be remembered that my cocoons were specially good; and besides that the grower's great endeavour is to pass off half dry as wholly dry cocoons.

I have written again to the Deputy Commissioners of submontane districts urging them to sow or plant more mulberries and especially bush mulberries. The value of mulberry leaves as fodder for milch cattle makes it worth while to plant even if sericulture does not spread.

Poultry.

10. The poultry at Lyallpur have been nearly wiped out by cholera. The accommodation was small and unsuitable. New runs in a more suitable place have been put up, and we shall try again. In paragraph 41 of last year's report reference was made to a lease granted to Duffadar Ghulam Muhammad for a poultry farm. This venture has been a failure, partly owing to disease, but chiefly from economic causes. I have reported for cancellation of the lease with the lessee's concurrence. At present market prices for eggs and fowls, it is quite impossible for a utility poultry farm, run solely as such, to pay. Even the cost of feeding is not covered by the sale price of eggs and birds. The poultry dealers of Gujar Khan seem to have a wonderful organization and to have almost a monopoly of the supply of fowls in Simla and other large towns; and it might be more hopeful to try to improve the strain of country fowls through them instead of in opposition to them.

Date palms.

11. Date suckers have been imported from the Persian Gulf and are being grown at the Multan Central Gaol and in Multan, Muzaffargarh and Lyallpur. There is an Arab from Basra to look after them. So far the young trees are doing fairly well; but it will be several years before there is any fruit. The work on dates is in the hands of the Economic Botanist, and he has given local demonstrations of hand pollination, which is said to be unknown in the Punjab. Arrangements have been made for the import of some more suckers this year. A detailed note on date palms has been written by the Economic Botanist and is now in the press.

Demonstration, etc.

12. As regards demonstrations, Appendix VI paragraphs 2 and 3 should be read. The fact is that owing to want of staff—especially of superior European agriculturists—demonstration work is much restricted. Personally I regard the extension of work into the districts and the bringing into closer touch of the expert department on the one hand and the district revenue officials and the cultivators on the other hand as the most urgent work before us. I have a scheme on hand for that, but its realization depends largely on the ability of the staff to cope with more scattered work. At present few zemindars know that there is an agricultural department at all, and even most Deputy Commissioners neither ask for nor obtain advice or assistance.

Applications for seed were met, as far as possible, from the Lyallpur farm and 23 maunds of Hansi and farm-selected cotton seed and 135 maunds of wheat seed were sold.

Agricultural Engineering.

13. Mr. Milligan has in Appendix VI dealt fully with well boring and agricultural implements. The Professor of Agriculture reports that during the year an effort was made to induce the farm tenants to use furrow turning ploughs and to harrow more with very encouraging results. The yield of wheat on the tenants' area of 113 acres averaged 12 maunds 13 seers which compares favourably with the results in 1910, *viz.*, 12½ maunds the acre. There is not sufficiently close supervision of the well borers and a European Agricultural Engineer is urgently required. Till we get such a man little progress can be made in the double problem of—(1) increasing the supply of water in wells; (2) raising the increased supply economically. There is comparatively little use in increasing the water supply in a well beyond the capacity of a Persian-wheel or bag lift if we do not also shew the zamindar how to raise it out of the well. There are also other problems as to increasing the supply of water in wells by percolation awaiting some one to tackle them.

Similarly in regard to agricultural machinery, Mr. Milligan has a taste for engineering but another Deputy Director of Agriculture might not have the same tastes and would not be so ready nor indeed qualified to devote time to the details of machinery improvement.

Publications and supply of information.

14. The following bulletins were issued during the year:—

(1) Practical hints for bee keeping in Simla—(a leaflet).

(2) Notes on silk-worm rearing in the Punjab with a separate leaflet of "Brief instructions for rearers of silk-worms."

Bulletins in English do not reach the cultivator. I hope to start the issue of vernacular leaflets regarding improved methods of cultivation, implements and so on, which have been thoroughly tested.

15. I am sorry that the report is a few days late.

W. S. HAMILTON,

The 14*th September* 1911. *Director of Agriculture and Industries, Punjab.*

APPENDIX I.

EXTRACTS FROM THE ANNUAL REPORT OF THE PRINCIPAL, PUNJAB AGRICULTURAL COLLEGE, FOR THE YEAR ENDING JUNE 30TH, 1911.

The session.

1. The second active session of the Punjab Agricultural College commenced on July 20th 1910 with a second year class of 10 students and a 1st year class of 25 students, a total number of 35. Four students withdrew from the 1st year's course during the session.

Character of the session.

2. The students of the 2nd year have made great progress—very much in advance of that made last year when they were new to the work. There were no failures among them at the sessional examination held in May. As to the 1st year class, the remarks made last year apply equally strongly if not more so in their case. Their knowledge of English when entering the College is scanty, while the environment in a scientific and technical institution must at first feel strange, and this accounts in some measure for the comparatively slow progress made in the first few months of the session. The percentage of failures in the sessional examination, *viz.*, 22 per cent., is however by no means excessive.

Practical agriculture.

3. The progress made in practical work is very satisfactory. No difficulty whatever is experienced in getting the men to do all the various kinds of manual work necessary on a farm. This is by no means the case in all Agricultural Colleges in India, where often the practical agriculture is regarded as a hardship. The 2nd year men were given more independent charge of plots of land and carried out some simple experiments under the direction of their teachers. It is proposed to devote the 3rd year to the study of animals, their feeding and management, dairying, and general farm and estate management. The student's farm has now attained its final area of about 40 acres and is being permanently laid out into students' plots and demonstration areas.

Science subjects.

4. The progress made by the students in science subjects is very gratifying, and shows that there is no doubt of the course being assimilated.

Museum and teaching collection of plants.

5. A collection of the crop products of the province brought from the Lahore Exhibition has been arranged in the Museum of the Agricultural College. The collection is a very representative and instructive one, and should consequently be of great value to the College and the department. Progress has been made with the garden of the teaching collection of plants.

Hostel.

6. The extension of the boarding house proposed last year received the administrative sanction of Government. The estimated cost of the whole extension is Rs. 51,000, but only part of this amount, *viz.*, Rs. 17,000, sufficient to build the necessary accommodation was sanctioned this session. This part of the work will, it is hoped, be ready by the end of July.

A considerable improvement in the working of the college boarding house for students has taken place during the past year under the superintendentship of Mr. Ram Gopal. Rules and regulations have been carried out in a much more efficient manner and to the satisfaction of the Principal. Every effort is being made to render the leisure hours of the students pleasant and attractive by sports and college societies, and both the College Athletic Club and the Scientific and Literary Society are in a flourishing condition. Two rooms of the College have been set apart as Students' Reading Rooms and these are now being furnished and will be managed by a committee of students under the chairmanship of one of the assistant staff.

Workshop and electric plant.

7. The machines and fittings received for the workshop were erected during the year under report. The electric plant etc., is ready for work and the official test will probably be carried out early in August.

Entrance Scholarship Examination and applications for admission.

8. The Entrance Scholarship Examination was held on 9th May 1911 and the following days. Six nomination forms were received from Deputy Commissioners and four candidates only presented themselves for the examination. Of these one had passed the Entrance Examination of the Punjab University and the remaining 3 appeared in April of this year. As a sufficient number of nominations were not received, some 5 ordinary students

who were eligible in every respect, except that they had not been nominated by Deputy Commissioners, were recommended for scholarships. There were 81 applications for admission as ordinary students.

The above figures speak for themselves. Of the 29 districts of the Punjab only 5, *viz.*, Ludhiana, Hoshiarpur, Jullundur, Gujranwala and Multan, sent up nominations. This lack of interest and indifference on the part of the district officers militates very strongly against the success of the College. As previously pointed out by the Principal and the Director of Agriculture and in Government Proceedings No. 190, dated 27th October 1910, the Department has no other means of getting into touch with large land-holders, etc. One of the main objects of the College is to educate the sons of men of this type who will afterwards return to manage their own lands. * * * * *

Admission of students.

9. The first year class in the coming session will, when all have joined, probably consist of the following :—

Scholarship-holders	... ...	8
Native States and North-West Frontier	... ...	9
Ordinary	... ...	20

The remaining two scholarships will be awarded in August after the first year men have been some time in residence.

Some difficulty has been experienced this year on account of the alteration in the date of the Punjab Universiy Matriculation Examination. It is now impossible for candidates for admission to the Agricultural College to send their applications in the same year that they matriculate and this will entail some alteration in the college syllabus. Either it will be necessary to alter the date by which the form must be sent in and with it the date of the Entrance Scholarship Examination or else retain the conditions of the syllabus trusting to candidates to employ their time for one year by attending science classes in some other college. The case has been discussed fully in Mr. Barnes' No. 239—3-2, dated the 15th March 1911, to the Director of Agriculture, Punjab. It has been decided to wait for one year before making any change as many important features of the College course are involved. It is for this reason that Mr. Barnes has asked for the appointment of a lecturer in Physics and Mathematics for one year only, as the question of raising the Entrance standard and eliminating these subjects from the College syllabus will be fully considered in making final proposals at the end of the 1911-12 session.

Caste of applicants for admission.

10. Below will be found the caste of the applicants for admission together with the division from which they come. Jullundur division accounts for nearly double the number from any other division :–

List of applicants.

Division.	Hindu.	Sikh.	Muhammadan.	Total.
Delhi	7	...	1	8
Jullundur	10	11	7	28
Multan	8	...	...	8
Lahore	4	9	3	16
Rawalpindi	5	2	4	11
Native States and North-West Frontier	4	4	2	10
Total ...	38	26	17	81

Income.

11. The income paid into the Government treasury during the year was Rs. 3,818-0-6 as compared with Rs. 768-11-0 in the year 1909-10. The increase is due to increase in the number of students, also increase in the rate of boarding house fees, which have been raised from Re. 1 per mensem to Rs. 32 per annum, thus making the boarding house self-supporting. The College fees have also been realized during the year for 12 months, instead of 9 months. The increase in the rate of College fees from Rs. 8, Rs. 9, and Rs. 10 to Rs. 12 and Rs. 16 per mensem will take effect from the ensuing session, which will commence from July 20th, 1911.

Punjab Agricultural College library.

12. The library has undergone many improvements in administration and in value during the year under report. At the end of June, it consisted of 7,500 volumes. Of this number 900 volumes were obtained during the year under report An effort is being made to develop the library not only in the pure science sections, but also in general literature on economic questions which will be specially valuable for the use of students.

W. ROBERTS,

Offg. Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

LYALLPUR AGRICULTURAL STATION.

Professor of Agriculture's Report.

I.—*Season* 1.—The season was on the whole favourable, and it was particularly favourable to cotton on account of the timely rains. The total rainfall for the year was 19·75 inches as compared with 21·01 for the previous year and an average of 22 inches for the last three years and 13·7 inches for the last ten years. Copious rain fell in June—over 5 inches—and enabled a fair area of San (hemp) to be sown without using irrigation water. The rain in the kharif was well distributed. The unusual and prolonged rain (8 days in March) when the wheat was coming into flower prevented proper setting of the seed in many cases and thus caused the yield to be less than might have been expected, *vide* statement I.

II.—Sugarcane, maize and cotton manurial experiment.—Briefly this experiment is intended to test the effect of organic and nitrogenous manure on sugarcane and the residual effects on maize and cotton in the succeeding two years. The accompanying diagram shows at a glance the treatment of the various plots :—

↑C	Castor cake.	Castor cake.
	Ma	ize.
	Castor cake and calcium nitrate ...	Castor cake and nitre.
B	Farm yard manure ...	Farm yard manure.
	Cot	ton.
	Farm yard manure and calcium nitrate ...	Farm yard manure and nitre
↑A	Green manuring ...	Green manuring.
	Sugar	cane.
	Green manuring and Ca $(NO)_4$ ...	Green manuring and nitre.

Manure is applied to sugarcane only.

Senji is sown in the maize and cotton areas in September, October, and cut for fodder except when cotton grows in plot A when the senji is ploughed in as green manure. The result will now be considered for each crop separately—*vide* statements II, III, IV, V, VI.

(*1*) *Sugarcane* (*statement II*).—The sugarcane crop failed on half this area and was ploughed up, hence the outturn of one acre only is given. It will be seen that the crop was good in both plots. Thirty maunds per acre of Gur is regarded as a good outturn in this colony. Apparently the smaller dressing of nitrate put instead of green manuring was sufficient to give a full crop.

(*2*) *Maize* (*statement III*).—The residual effects of a dressing of castor cake with and without the addition of crude nitre and calcium nitrate applied to the previous crop of sugarcane was tested in this area. It will be seen that an increased yield of from 1¼ to 1½ maunds was obtained in the two areas where nitrate had been applied.

(*3*) *Cotton* (*statement IV*).—As might be expected there is no increase in the manured plots, but on the whole the yield in these two plots together is 1½ maunds less than the total of the plots which did not receive nitrates in addition to a general manure. Nitrates are soluble and easily available manures and would naturally have no effect two years after application and after serving two previous crops, *viz.*, sugarcane and maize together with a catch crop of Senji.

(4) *Senji sown among maize* (*statement V*).—A total increase of 17 maunds of fodder probably due to residual effect of the nitrates.

(5) *Senji sown among the cotton's* (*statement VI*).—The yield in manured plots here is less than in unmanured plots by 27 maunds and 5 maunds respectively, and a total of 32 maunds. This corresponds with the results in case of the previous cotton crop.

III.—Sugarcane subsoiling and variety experiment (*statement VII*) —In the case of Kahu and Dhaulu varieties subsoiling has this year given an increase—slight in the case of Dhaulu and heavy in the case of Kahu. In this connection it is necessary to note that plot A-I of Kahu was next to a row of trees, and this might have materially decreased the yield in which case the difference between ordinary and subsoiled portion would have been less. This area is being abandoned for the above reason and in future the experiment will be conducted on a more suitable area.

IV.—Varietal experiment.—The yield of Gur per acre from Kahu is greater this year than from Dhaulu. The quality however was poor and about 7 maunds of it could not be sold in the bazaar. This variety of Kahu is only grown in Lyallpur in small quantities near towns as a chewing cane.

V.—Cotton.—Subsoiling experiment (*statement VIII*).—This experiment was conducted in a new area in square 9. As might be expected no positive result was obtained. In experiments of this nature a test on the same area for a number of years is necessary as the stirring of new soil from below is not likely to show any result until it has had time to weather somewhat. A permanent experiment is being arranged.

VI.—Cotton.—Ridge and flat sowing experiment with Hansi cotton (*statement IX*).—The most remarkable feature in this experiment is the high yield obtained, the average of three acres being over 14 maunds per acre. The outturn of nearly 16 maunds in plot 2 is the record so far obtained on the estate. As will be seen the yield was higher this year on the flat while last year the ridged area gave an increased yield over the flat portion. Sowing on ridges entails extra labour and often extra water, so that it may be stated with some confidence that in good soil sowing on the flat is the beet method. It is not proposed to repeat this experiment.

VII.—Water requirement of Desi and American cotton (*statement X*).—The American cotton has given over two maunds higher yield per acre, but required one more watering. In the previous year two more waterings had to be given to American cotton.

VIII.—Residual effect of calcium nitrate manure on wheat and result of furrow-turning plough and harrow versus *country plough "Munna"*.—From statement XI it will be seen that there is no effect from the dressing of calcium nitrate given in the previous year.

As regards the second part of the experiment it should be noted that four and a half to five acres can be treated with the harrow in the same time as one acre can be ploughed with the country plough, using the same labour in each case. Nine harrowings therefore cost as much in labour as two ploughings with the country plough. From this point of view therefore the plots treated with furrow turning ploughs and harrows have received only half or less of the cultivation given to the other plots. This probably explains the higher yield of one maund obtained in the plots cultivated with the country plough.

IX.—Calcium nitrate experiment with wheat.—It will be seen from statement XII that an increased yield has been obtained in all plots except one where the decrease is ¾ maund. The value of the increase is however in all cases less than the expenditure. The total value of the increase, *viz.* Rs. 32, would pay for the manure at the rate of Rs. 4 a maund. It will be noticed that the increase in yield is greater in the poorer plots than in the better ones.

X.—Desi versus *furrow-turning plough with wheat* (*statement XIII*).—This experiment was carried out in two squares, *viz.* two killas in square 12 and four killas in square 7. In the former case it will be seen that the number of ploughings with the country plough is 4 and with the Raja plough 2 together with two harrowings. The treatment here is more even from the labour point of view than was the case in square 29 (*vide* paragraph VIII). The outturn shows the plots cultivated with the Raja to have given a slight increase of about ¾ maund per acre.

In square 7 the reverse is the case, the average yield per acre being ¾ maund less than in the case of the area cultivated with the country plough. This agrees with the result in square 29.

XI.—Hot weather versus *rain ploughing* (*statement XIV*).—Owing to the hot weather ploughing have been delayed in some plots and the advent of early rain, thus minimising the burning effect of the sun's rays, this experiment is not reliable. The experiment covered 8 acres and the average increase of hot weather plots over the remainder is 1¼ maunds per acre.

XII.—Green manuring with San (hemp.)—In the season under report an area of three acres in square 26 which in the previous year yielded only 11 maunds 31 sers of barley, or 3 maunds 37 sers per acre was sown with San (hemp) in early July and ploughed in the first week in September. Barley was again sown in November and harvested in April and May, the total yield being 50 maunds 3 sers, or 16 maunds 27 sers per acre. This result is in many ways remarkable. The area in question is somewhat sandy and inclined to kallar in some places. The San was sown after rains and was only given one irrigation, being ploughed in when in flower by means of a furrow-turning plough. The San crop was an excellent one being 6 to 8 feet high and its effect was probably more due to physical causes in ameliorating the soil and combating the kallar than in increasing the plant food supply. More work in this line has been taken in hand.

XIII.—Wheat types sown at the Lyallpur Agricultural Station (types Nos. 9 and 11).—These two types were grown in a fairly large area this season, No. 9 occupying 18 acres and No. 11, 16 acres. Type 9 stood better than 11 this year in every case where the crop was heavy. As a yielder, however, No. 11 heads the list in all cases where the two types were grown side by side (*vide* results in square 26, statement XV, and in square 10, statement XVI).

W. ROBERTS,

Professor of Agriculture, Punjab Agricultural College, Lyallpur.

APPENDIX III.

Lyallpur Agricultural Station.

Economic Botanist's report.

Cottons.

General.

The cotton experiments occupied one of those plots set apart for cotton and wheat experiments. The area of this plot was 10 acres. The land was a medium loam in fair condition. Two patches of the land each about ¾ acre in extent, were poor; one owing to alkali in the soil, the other owing to Baru grass (Sorghum halepense). The season was fairly favourable and no disease did exceptional damage. Except on the two poor patches already mentioned the plants grew to a fair height and appeared as healthy as may be expected. The crop was fairly regular and with the exceptions referred to above the outturns from the different plots may be considered fairly comparable.

Buri cotton.

2. In previous years it was noticed that Buri cotton ripened very late, therefore in the year under report it was sown a month earlier than the majority of cottons. The crop as usual grew luxuriantly and appeared very healthy throughout the season. When general picking started among other cottons in early October however, there were yet no flowers on the Buri cottons. They began to produce flowers in the last week of October and a first picking of lint was got from them late in December. After this picking frosts spoiled the crop. The Buri cotton was obtained from the Bengal Department of Agriculture in 1907. Each year since then the crop has been too late to be of any use. Evidently this cotton is too late for Lyallpur.

Combodia cotton.

3. A sample of Combodia cotton was obtained last year and sown on the same date as the Buri cotton mentioned above, as it was believed to be a very late ripening variety. Like Buri it gave its first picking late in December. It is evidently also too late for Lyallpur.

Egyptian cottons.

4. Ashmoni, Metafifi, Yanovitch and Abbasi cottons were again grown here, but with the same miserable results as previously. The experiences of the past four years indicate that these cottons are of no use in Lyallpur.

Dharwar American cottons (see statement A).

5. These were sown in the ordinary cotton sowing season here. The leaf buds and early bolls were nipped off the plants in early August to improve the habit of the plants and check boll worms. No serious loss was caused by boll worms last year. The crops on the plots were fairly regular. It was therefore possible to make useful comparisons and, with the help of the very close notes which have been taken on these cottons for the past three years (see report 1908-09), to discard a large number of undesirable types.

The types now retained are the best of the huge collection of Dharwar American cottons handed to me when I took up the cotton work here. So far as I have seen these cottons are all better than any Dharwar cottons grown in the province at present. Several of them were valued above middling Americans last year by the British Cotton Growing Association, Liverpool, and by the Chamber of Commerce, Bombay. The method of selection has been that described on pages 5-6 of the Annual Report for 1908-09 of the Lyallpur Agricultural Station. There is room for further work on these cottons.

Desi cottons (see statement A).

6. Desi cottons have this year given excessively high outturns. These outturns have indeed exceeded the outturns from Dharwar American cottons. The yields of the best Desi varieties ranged from about 15 to 17 maunds per acre on plots of $\frac{1}{8}$ acre in extent. The season seems to have been specially favourable to the Desi crop. In the past two years the Dharwar Americans on the experimental area here gave better outturns than the Desi cottons did.

Collection of Punjab and N.-W.F. Province cottons.

7. Herbarium specimens and samples of lint of the types into which the collection of cottons of the Punjab and North-West Frontier Province have been run have been in the hands of the Imperial Cotton Specialist for opinion during the year. The Imperial Cotton Specialist is expected here during this cotton season and will doubtless deal with the case after seeing the cottons growing in the field.

Crossing of cottons.

8. In order to gain experience in the Punjab, some crossing of cottons was done in the past year. As many natural crosses have been found in past years and the amount of natural crossing may seriously affect the method of distribution of cotton seeds and cotton work here in future, some steps have been taken to ascertain the extent of natural crossing that takes place in ordinary conditions. It is hoped that more time may be spared to this work in future.

Conclusions.

9. The results of the past few years show that Kidney, Spence and Caravonica Tree cottons, African cottons, Egyptian cottons and Buri and Combodia cottons have been failures here. The best cottons in the Punjab appear to be the Dharwar American cottons and the indigenous cottons. Six Dharwar American selections have been up to date handed over to the Professor of Agriculture, Punjab Agricultural College, Lyallpur, for trial on larger areas before being finally recommended to cultivators.

Wheat and other cereal grains.

General.

10. The wheat experiments covered about eleven acres of ground. Ten acres of this was in the experimental area set apart for wheat and cottons, and one acre was in the non-experimental area. On the one acre area a number of varieties were grown, the outturns of which had not to be compared. The ten acres of land in the experimental area was of a rather light loam. It was of fairly even quality however and much about the standard of ordinary farmer's lands around here. The previous crop was cotton and this was removed in January 1910. From that time it lay fallow till November 1910. Between February and October the whole experimental area received the following treatment :—

Ploughing with Diamond plough	2
Ploughing with Native plough	1

To prepare the seed bed it received in addition —

Irrigation	1
Ploughing with Native plough	1
Cultivation with Horse Hoe	1

The dates of sowing were 7th to 17th November 1910.

The crop received three irrigations throughout the season. Practically no weeding was required. No manure was applied.

There were severe frosts in December and January, but apparently these did not harm the wheats. From 8th to 18th March the weather was damp and there were frequent rains attended with high winds and occasional hail. During this period the crops lodged badly and rust spread rapidly and did much damage. The outturns on the botanical experimental area this year were consequently much lower than those of last year. The crop throughout the colony was also a comparatively poor one this year. About 300 different sowings of wheats were under observation. The size of the plots ranged from $\frac{1}{32}$ to $\frac{1}{4}$ acre area (see statements B, C, D.).

They were long and narrow and Lal Kale Kasarwali, a common wheat in the colony, was again grown at intervals of about 34 yards as a standard, to check unevenness in the quality of the soil. The relative positions of the standard variety were the same as those in the statements. They give a fair indication of the inequalities of the land. In comparing the outturn of any variety the outturn of the standard varieties near should be considered.

Australian wheats (see statement B).

11. The twenty Australian wheats grown last year were again grown this year. They again grew to a good height, they did not lodge badly, but ripened late and were severely damaged by birds. Practically the same result has been got now for the past three years. It has therefore been decided to reject most of them in the coming year. A few of the best varieties will be kept for crossing or other purposes.

Selected indigenous wheats (statement C)

12. The 42 selections of stray indigenous wheats made by various people at different times were again grown this year. The 4 new varieties discovered among them and 13 varieties corresponding to the Punjab classified types and giving markedly good outturns have been retained (see statement C). The remaining 25 selections corresponding to one or other of the Punjab classified types have been rejected as they appear to be no better than the classified types they represent.

Punjab classified wheats (see statement D).

13. Seed of each of the classified types of Punjab wheats, sufficient for experiments on a field scale, were handed over to the agricultural section last year. The plots on the botanical experimental area this year were therefore grown chiefly to maintain in the department a stock of pure seeds of these types. Plots of these types will have to be grown in the botanical experimental area every year so that a pure stock of seed may be available if required at any time in future. The results got from these plots this year will be seen in statement D. The information obtained from observations on the Punjab classified wheats while growing here and information concerning them collected during that time practically confirms the statements made regarding these by Howard and Howard in " wheats in India. "

Stray plants in pure cultures.

14. A number of wheat plants not true to type have been found in the plots of Punjab classified wheats and in the selected indigenous and Australian wheats in the botanical area. The characters of these plants have been carefully recorded and the seed will be sown next year to obtain information as to how many of the plants are natural crosses.

Crosses.

15. Last year a number of crosses were made. The seeds of these were sown this year. They germinated well, but rust affected them badly in spite of the fact that they were sown very thinly. They all produced good heads of well developed grains however. Notes were carefully recorded of the characters exhibited by these plants Many of the characters were very interesting. A few more crosses were made this year.

Jute.

16. Two points in connection with jute experiments here required further elucidation in the psat year.

These were—

(*a*) the probable cost per maund of stripping and washing the fibre,

(*b*) the outturns of fibre that might be reasonably expected from ordinary zamindari lands.

It was found that the cost of stripping and washing a maund of fibre amounted to about Rs. 6 per maund. This expense would of course make jute cultivation impossible with any profit. The high costs are due to the very high price of labour here. It may be that the men in this district cannot strip and wash jute fibre as fast as people can in jute-growing districts, but even allowing for that the expenses appear prohibitive. In order that information might be obtained on the second point the Professor of Agriculture very kindly had two acres of jute grown on tenants land on the Lyallpur farm. The outturn of fibre got was about 4½ maunds per acre. With outturns of this sort and the expenses above mentioned, jute cultivation cannot be recommended to farmers. The experiments have, therefore, been stopped. It may be mentioned, however, that very good valuations have been obtained during the past three years for jute fibre grown here. Last year the valuations reached the top price in the Calcutta market. This year two samples were sent for valuation to Messrs. Mackinnon Mackenzie and Co., of Indian Jute Company, Calcutta, and their report on these is as follows :—

> *Example No.* 1.—Shows a good clean string fibre of bright colour and fair length value on to-day's market Rs. 10-8-0 per maund (82 lbs.) in Calcutta.
>
> *Sample No.* 2—Fair quality of a low medium grade, value on to-day's market about Rs. 8-4-0 per maund (82 lbs.) in Calcutta.

Maize and Jowar.

17. The maize and jowar varieties collected from the Lahore Exhibition and elsewhere last year were sown. Practically all turned out to be crosses.

Miscellaneous.

Canal weed—Euphorbia thymifolia.

18. Some attention has been given to the discovery of a means of eradicating this pestilential little weed from grass lawns. A full report on the work done will be put up in due course.

Fruit cultivation.

19. In February 1911, a number of fruit trees of the province were collected and planted in the area set apart for the fruit collection. Some fruit cultivation experiments were also started. These experiments are intended chiefly to provide object lessons to students.

Smyrna figs.

20. The Smyrna figs are doing well.

Cryptostegia grandiflora. (The rubber plant of the Punjab).

21. Seed of Cryptostegia grandiflora has now been received and a nursery is being started.

Exhibitions.

22. A set of exhibits intended to be reserved for sending to exhibitions in other provinces, when such exhibits are asked for, was formed. These include representative samples of the chief crops of the province. Full length samples of wheat plants to show the length and quality of the straw, threshed grains, flour, bran, etc., for comparison were included. The part referring to cottons is composed of such items as herbarium specimens, bolls, ginned and unginned fibre of the various cottons grown in the province, also a very fine case of samples of cottons of the world and showing the different stages in the manufacture of cotton cloth by Messrs. Horrockses, Crewdson and Company, Limited, Manchester. Other crops are represented similarly. Coloured statistical maps, diagrams and other items giving information on the crops of the province also form part of the collection. This exhibit was sent by request to the Agricultural Department, United Provinces, for the Allahabad Exhibition. It has been returned in such a poor condition, however, that it is doubtful whether such an exhibit can be kept up.

A small set of exhibits was also sent to the Secretary of the Mysore Dasara Exhibition.

D. MILNE,

Economic Botanist, Punjab.

APPENDIX IV.

GURDASPUR AGRICULTURAL STATION.

Deputy Director of Agriculture.

1. There is no experimental report for this station the land for which was acquired in October 1910. The total area is about 104 acres, of which about one-half was under timber. Clearing and levelling has been almost completed. Roads and paths have been made and the first rotational crops have been sown. An attempt has been made to hurry on the necessary crop testing experiments, and it is hoped that next year will see a beginning with the permanent experiments on sugarcane and wheat. The two main subjects of experiment will be the sugarcane crop and the investigation of the possibilities of increasing the fertility and moisture capacity of barani soils. The farm is divided into two distinct areas—chahi or well-irrigated and barani. It is not proposed to use canal-water. The wells will be used for testing improved water lifts and improved water supplies.

A 3½ H. P. Hornsby Oil Engine and a 3″ centrifugal pump have been purchased and the plant is at present lifting water from a depth of up to 38 feet. The present well will not stand any more pumping, but it is hoped that with a new well a paying discharge will be got at a depth of about 42 feet.

S. MILLIGAN,

Deputy Director of Agriculture, Punjab.

APPENDIX V.

REPORT ON CHEMICAL RESEARCH BY AGRICULTURAL CHEMIST.

Provincial Chemical work—Reh.

1. The chemical work of my programme for this year has been considerably retarded owing to lack of staff. A preliminary survey of the constitution of the alkali infected soils of the province has been concluded and a report embodying these together with recommendation for reclamation experiments is about to be sent to the Director. The observations so far made endorse the opinion of other workers that the cause which leads to the formation of these salts is entirely climatic and geographical, *viz.*, high variation of temperature combined with insufficient rainfall and drainage to wash away the salts resulting from weathering. The conditions which lead to the accumulation of salts in patches, particularly in irrigated districts is under investigation and, so far as can be said at present, seems to be closely connected with the denser texture of the soil underlying such affected areas. The only rational treatment for alkali affected lands appears to be irrigation combined with artificial drainage and the problem from this point assumes an economic aspect. I am of the opinion that only lands commanded by an adequate supply of irrigation water can be successfully treated and cured, for treatment by chemical manures is inapplicable except in very isolated cases such

as a small amount of sodium carbonate in a "black usar" soil together with an absence of excess of other salts, when treatment with nitrate of lime will yield satisfactory results. Such cases are however rare. There is every reason to believe that canal irrigation tends to accelerate the production of soil salts, and it is of importance that the canal system for the future should allow for adequate drainage so that such salts may be carried away in solution and collected if necessary. I have mentioned in the report that from data supplied the subsoil water of the Chenab canal colony is rising at an alarmingly rapid rate from seepage from the canals, that in 50 years or less a large portion of the colony will exhibit water-logging conditions, in which case the land will become infertile both from the permanent fixation of alkali as well as from souring of the land and the cost of reclamation will be considerably advanced.

Gur and Shakkar.

2. Some samples of gur and shakkar from the Gurdaspur district were taken last cold weather and analysed. They showed on an average a close resemblance in composition to the gur of the Cawnpore district as analysed by the United Provinces Department of Agriculture. The climatic conditions of the two districts are very similar notwithstanding that the cold weather is a little earlier and longer in Gurdaspur. The methods of improvement of cane cultivation resulting from Cawnpore investigation will probably be found capable of application in Gurdaspur. This subject is to be further investigated during the forthcoming sugar season, when, if staff is available, the canes of the district will be classified and valued. I propose to consult with the United Provinces Department of Agriculture on the subject during the sugar season.

General analyses.

3. Some 35 other samples of wheats, oats, manures, etc., have been analysed during the year for intra and extra departmental purposes. The wheat samples were selected from the chief wheat-growing districts of the province and were analysed and classified with particular reference to their export values. The results were not conclusive and much further investigation of the subject is required.

Oats.

4. Some samples of oats were analysed with reference to their cattle feeding value on behalf of the Registration Officer and Commandant, Guarantee Camel Corps, Lyallpur.

Rubber.

5. A sample of the rubber made from the cryptostegia grandiflora by Mr. Bruere of Karnal was analysed and valued. It appeared to be a rubber of high value and remarkably free from oxidisable resins—a great drawback to the West African rubbers. Some samples of rubber were prepared from the ak (calotropis, sp:) but this was so contaminated with quantities of oxidisable resins as to be quite useless for market purposes.

Grain preservation and storage.

6. Some experiments with wheat and grain preservation have been started this summer at Lyallpur and Rawalpindi with the object of preventing weevil in masses of stored grain. The Chief Supply and Transport Officer, Rawalpindi division, is co-operating.

APPENDIX VI.

REPORT ON WORK OUTSIDE THE AGRICULTURAL STATIONS BY THE DEPUTY DIRECTOR OF AGRICULTURE.

American cotton.

THE area under cotton grown from Dharwar acclimatized seed issued by the department was about 1,000 acres. The usual arrangements were made for the sale of the produce by auction. Prices were satisfactory, Rs. 11-3-0 to Rs. 11-5-0 per maund being obtained, desi cotton being Rs. 9-12-0 to Rs. 10 on the same date. Sales of new seed though remaining steady are not increasing. At the same time a considerable area of the Punjab acclimatized variety is being grown by the Jangli settlers on the Jhang (Canal) division in the Chenab Canal. Last year considerable arrivals at Gojra and Jhang met a ready sale at prices a trifle over rates for desi cotton. One ginning factory at Jhang reports having purchased 24,000 maunds but it is doubtful if the sample was pure. It is quite evident, however, that the area under this variety has become fairly large in that part of the colony and that the crop suits the style of cultivation practised by the Jangli. An attempt will be made to assist buyers in obtaining full market rates for unmixed stuff.

Agricultural machinery.

2. The policy of the department continues to be not to recommend machinery so much as to teach improved methods. For the adoption of such in many cases machinery and implements are necessary but in declining to boom machinery we have no doubt saved many people from purchasing stuff which would have been of little or no use to them. Messrs. Volkart Brothers still continue to sell machinery recommended by the department, and are the only firm in the province with a really well equipped agency. The sales of implements noted below are those distributed by the firm in question.

Harvesting machinery.—The total sales of new Reapers during the year amount to 51 against 72 last year. The sales are confined to the canal tracts in Lahore and Lyallpur districts. There has been a decline in the demand from Lyallpur district, while that from Lahore district remained steady. The reason is probably that the Lyallpur people, who generally buy co-operatively and have small holdings, were fully occupied in purchasing the proprietory rights of their lands. The department rendered the usual assistance to new buyers and the new machines with one exception were quite satisfactory. A practical demonstration by Harnam Singh, Chak Sherewala, Ferozepore district, was largely attended by his neighbours and very successfully carried out with a little assistance from our department. A small depôt for the sale of spare parts has been opened by one of the Raewind zamindars and should be useful to his neighbours.

Winnowing machines.—Volkart Brothers have imported a limited quantity of the machines, a specimen of which obtained the gold medal at Allahabad. Extended trials at Lyallpur this year give an average capacity of one ton of bhusa per hour or from six to nine maunds of grain according to the fineness of the bhusa. The highest rate was 33 maunds of barley for a 3¼ hours run. The result gives an average of about 15 per cent. above the designed capacity of the machine. The design can, therefore, be strongly recommended, but the present machine will require to be strengthened structurally to withstand the severe weather in May.

Threshers.—I regret that owing to the delay in opening the Lyallpur College Workshops little progress has been made in carrying out experimental work on bullock power wheat threshers. The importance of this line of work is becoming increasingly apparent.

Steam threshing.—An important experiment was conducted by Messrs. Ransomes Sims and Jeffries of Ipswich at Gurdaspur and Lyallpur with a small steam threshing plant. The experiments lasted over a month and were conducted with great thoroughness by one of the firm's experts. After much labour in which an entirely new method of threshing and chopping was adopted a simple and efficient machine has been evolved. The machine is very free from complications, is very reliable and should suit the Punjab conditions. The capital outlay, Rs. 4,500, though small for a steam threshing plant, would necessitate co-operative purchase or a system of contract hiring.

Ploughs.—Iron ploughs are recommended by the department for special purposes only such as the destruction of deep-rooted grass, &c., but a considerable number of the "Raja" type continue to be sold for general purposes. The number distributed from Lyallpur during this year amounts to over 200 out of which 50 have been sold to other provinces. While a large number of purchasers have undoubtedly found these ploughs useful and profitable there still remain some who have neither the perseverance nor the intelligence to make proper use of them. It should not be forgotten that an improved implement demands better judgment than a primitive one on the part of the user and also a good deal of initial perseverance. Our Agricultural Assistants and demonstration muqaddams are largely employed during the cold weather in visiting and instructing purchasers of ploughs, but owing to the smallness of the trained staff this cannot be done as thoroughly as it ought to be.

Other implements.—Other implements in fair demand are fodder cutters and harrows.

Outside demonstrations.

3. Outside demonstration work has been handicaped by the withdrawal of the larger part of my assistants and muqaddams to form the nucleus of the staff for the Gurdaspur agricultural station. It was not therefore possible to undertake any organized demonstration work during the cold weather, what remained of the staff being fully occupied in assisting purchasers of new implements, &c. Demonstrations were given at the Ambala, Rohtak (Jahazgarh), Chakwal and Lyallpur fairs, also by arrangement at Gulapur (Shahpur district), Ladhewala Waraichan (Gujranwala district), Gurgaon and Faridkot. The addition of two newly recruited assistants and 3 more muqaddams has made it possible to undertake practical demonstrations in some 30 villages in Lyallpur district this hot weather on the sowing and proper after cultivation of cotton.

The demonstrations consisted of the performing, by our own people, of the actual cultivation recommended by the department and the subsequent inspections necessary.

The centres for demonstration have been chosen so as to distribute them well over the district and to enlist the service of zamindars already in touch with the department's work. Results must be judged by the impression made on the villages as regards the cultivation of next year's crop.

Although demonstration work must be treated as being in the experimental stage, at the same time the necessity for concentration in this class of work is very apparent.

Well-boring.

4. The primary object of this department is the increasing of the water supply in existing wells and the conducting of trial borings for new well sites.

The sanctioned staff consists of three supervisors, twenty borers and twenty mates (assistant borers). A beginning was made last August by the purchase of ten boring plants and recruiting of the necessary staff. The remaining ten plants have been purchased out of this year's budget allotment.

The plants were distributed in the following districts :—

Gurdaspur	3
Hoshiarpur	2
Rohtak	2
Karnal	3

The final scheme as sanctioned for the twenty plants is as follows :—

Jullundur	3
Gurdaspur	3
Rohtak	3
Karnal	3
Gurgaon	2
Hissar	1
Ambala	1
Ludhiana	2
Hoshiarpur	1
Deep boring	1

The years's work consists of the working of the ten plants. While there has been little demand for trial borings there has been a good demand for the tubing of existing wells and the programmes of the borers have been fairly well filled up in advance. Operations are conducted on the same lines as in the United Provinces.

The work on the whole has been fairly satisfactory allowing for the fact that the staff has been recruited and trained within the year.

An analysis of the borings undertaken shows that in some localities there do exist considerable supplies of underground water at lower depths than are at present tapped by the ordinary wells. On the other hand they show that in other localities there is little chance of obtaining good underground supplies at reasonable depths. Rohtak may be taken as an example of the former, where the operations have been the most successful, and Hoshiarpur of the latter, where little success has been obtained.

In each case where the supply has been increased it has been brought about by sinking a tube in the well through a clay or kankar sub-stratum.

The results of well-boring operations from October 1910 to 30th June 1911 are as follows :—

District.	Number of wells bored.	Supply increased.
Rohtak	33	27
Karnal	30	19
Jullundur	6	5
Hoshiarpur	8	2
Gurdaspur	26	17
Total	103	70

5. There exists a fair demand near Lahore for this by-product as a manure for potatoes. The free distributions by the department for use in sugarcane fields do not appear to have led to any increased demand. The people have a distinct aversion for any drying manure for sugarcane and they are doubtless right in the matter. The problem will require to be studied at the agricultural stations and will probably revert to a question of the proper time of application.

Castor cake.

APPENDIX VII.

REPORT ON WORK OUTSIDE THE AGRICULTURAL STATION BY THE ECONOMIC BOTANIST, PUNJAB.

1. *Cassavas.*—The experiments with cassavas at Lyallpur, Ambala, Rewari (Gurgaon district) and Gurdaspur were repeated last year. The results were more discouraging than last year.

Two serious objections to the crop in the Punjab are—

(1) It is so extraordinary liable to be destroyed by white-ants that it could not be grown with profit by ordinary zamindars.

(2) The plants that have been grown, and which looked in perfection of health, when calculated as a crop with no blank spaces in it, yielded in the very best case only half of what is considered an average outturn per acre, and in most cases an outturn very much less than that.

Further experiments with cassavas have been stopped.

2. *Potatoes.*—A number of good varieties of Scotch potatoes obtained from Scotland for the Lahore Exhibition were planted at Mashobra after the exhibition was over. The Agricultural Department is indebted to the Deputy Commissioner, Simla, for having very kindly made arrangements for planting them there. The results got were satisfactory but the amounts of potatoes planted were small. Arrangements were made for the potatoes being again planted at Mashobra this year. They will be harvested in September.

The Deputy Commissioner, Kangra, asked for samples of good potatoes for trial in his district. Small quantities of several of the best varieties of Scotch potatoes were therefore got from Scotland and samples of a number of the best Italian varieties were got through a friend in Italy and sent to him. The experiments have been successful. The potato crop is of considerable importance in the Simla hills and in Kangra, and it is hoped that an improvement may be effected in the potatoes already grown in these places. A good deal of potatoes is also grown in the plains, the sets being obtained from the hills. The crop is considered a very profitable one both in the hills and the plains. Some Scotch potatoes, harvested in Mashobra last year in September and planted in Lyallpur almost immediately, showed no signs of sprouting or decaying until long after the potato crop should have started growth. Similar happenings frequently occur in Egypt and cause considerable losses to potato growers. It was thought that if potatoes are stored for some time before planting this might not happen. To test this the Mashobra potatoes planted here were dug up and stored until the February planting season. These potatoes all sprouted then along with others planted at that time.

STATEMENT No. I.

Showing rainfall at the Lyallpur agricultural station during the year 1910-11.

MONTH.		1910-11.		1909-10.		REMARKS.
		Number of rainy days.	Rainfall in inches.	Number of rainy days.	Rainfall in inches.	
June 1910 ...	1st half ...	2	2·28	...	...	
	2nd „ ...	3	3·14	2	1·02	
July 1910 ...	1st „ ...	...	...	4	4·62	
	2nd „ ...	2	1·72	3	7·23	
August 1910 ...	1st „ ...	2	1·89	1	·42	
	2nd „ ...	5	5·64	2	·32	
September 1910 ...	1st „ ...	...	...	5	4·46	
	2nd „ ...	...	...	...	...	
October 1910 ...	1st „ ...	...	...	...	...	
	2nd „ ...	...	...	...	...	
November 1910 ...	1st „ ...	...	...	...	...	
	2nd „ ...	...	...	...	...	
December 1910 ...	1st „ ...	1	·12	3	1·29	
	2nd „ ...	...	...	1	·10	
January 1911 ...	1st „ ...	5	1·03	3	·70	
	2nd „ ...	1	·16	...	...	
February 1911 ...	1st „ ...	...	...	...	...	
	2nd „ ...	...	...	...	...	
March 1911 ...	1st „ ...	11	2·37	...	...	
	2nd „ ...	2	·53	...	...	
April 1911 ...	1st „ ...	...	...	...	...	
	2nd „ ...	1	·71	3	·61	
May 1911 ...	1st „ ...	2	·16	1	·10	
	2nd „ ...	...	...	1	·14	
	Total ...	37	19·75	29	21·01	

STATEMENT No. II.

Showing the result of manurial experiment with sugarcane at Lyallpur Agricultural Station, kharif 1910.

		Area.				Weight of green tops.		Weight of cane.		Weight of juice.		Weight of gur.						
No. of square.	No. of plot.	Kanals.	Marlas.	Name of variety.	Treatment.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	Remarks.
27	$\frac{C}{1}$ part	4	...	Katha ...	Crude nitre 990 lbs. containing 130 lbs. of nitrogen per acre.	66	36	133	12	79	12	13	23	50·19	59·49	16·99	10·18	(1) Ploughings ... 3 (2) Weedings and hoeings ... 5 Waterings ... 13 Crushing began on 2nd January 1911. Finished on 31st January 1911.
27	Do.	4	...	Do. ...	Crude nitre 495 lbs. containing 65 lbs. of nitrogen per acre.	83	17	159	35	89	16	15	27½	52· 18	55·91	17·54	9·81	

STATEMENT No. III.

Showing outturn of maize grown in the manurial rotation series, kharif 1910, *at the Lyallpur Agricultural Station.*

			Area.		Weight of dry cobs.			Weight of dry stalks.			Weight of grain.			Weight of tukkas.*			Wastage in beating, &c.						
No. of plot.	Name of variety.	Treatment.	Kanals.	Marlas.	Maunds.	Sers.	Chhataks.	Maunds.	Sers.	Chhataks.	Maunds.	Sers.	Chhataks.	Maunds.	Sers.	Chhataks.	Maunds.	Sers.	Chhataks.	Maunds.	Sers.	Chhataks.	Remarks.
$\frac{C}{3}$ — Sq. 27																							
1	Red local maize.	Residues of castor cake 10½ cwt. per acre + crude nitre 495 lbs. per acre.	4	0	12	24	10	12	14	0	10	8	13	2	5	4	0	10	9	20	17	10	Ploughings ... 2 Harrowings ... 8 Weedings and hoeings ... ... 4 Waterings 4 Date of sowing—29th July 1910. Date of harvesting—30th October 1910. Badly lodged by a heavy wind after irrigation at the end of September 1910.
2	Ditto	Residues of castor cake 10½ cwt. per acre + calcium nitrate 560 lbs. per acre.	4	0	13	2	8	13	14	0	10	26	6	2	5	0	0	11	2	21	12	12	
3	Ditto	Residues of castor cake at 10½ cwt. per acre.	4	0	12	37	12	14	25	0	9	32	3	2	34	12	0	10	13	19	24	6	
4	Ditto	Ditto ...	4	0	11	6	0	13	12	0	9	13	10	1	22	2	0	10	4	18	27	4	

* Woody sockets left after removing grain from maize cobs.

STATEMENT No. IV.—*Of Manurial Experiment at the Lyallpur Agricultural Station.*

Variety of Cotton—Farm selected.

No. of Square.	No. of Plot.	Treatment.	Actual area.		Actual outturn.			Outturn per acre.			Remarks.
			Kanals.	Marlas.	Maunds.	Sers.	Chittaks.	Maunds.	Sers.	Chittaks.	
27 C/2 ...	1	Residues of farmyard manure at 15 tons per acre + 495 lbs. of crude nitre containing 5 lbs. of nitrogen per acre.	4	...	5	14	14	10	29	12	Ploughing = 1 Harrowings = 5 Weeding and hoeings = 6 Waterings, 4 Picking began on 19th September 1910. Finished on 28th December 1910.
	2	Farmyard manure 15 tons per acre + $Ca(NO_3)_2$ 560 lbs. containing 65 lbs. of N per acre.	4	...	4	25	11	9	11	6	
	3	Farmyard manure 15 tons per acre.	4	...	4	37	5	9	34	10	
	4	Farmyard manure 15 tons per acre.	4	...	5	32	5	11	24	10	

STATEMENT No. V—*Showing the residual effects of manures on Senji fodder sown after maize in C/3, sq. 27.*

No. of Square.	No. of Plot.	Treatment.	Area.		Outturn.			Outturn per acre.			Remarks.
			Kanals.	Marlas.	Maunds.	Sers.	Chittaks.	Maunds.	Sers.	Chittaks.	
27 C/3 ...	1	Residues of castor cake 10½ cwts., N. A. and crude nitre at 495 lbs. per acre.	4	...	51	35	...	103	30	...	Date of sowing—30th September 1910. Date of harvest—23rd March 1911. Waterings, 4.
	2	Residues of castor cake and $Ca(NO_3)_2$ 560 lbs. per acre.	4	...	75	10	...	150	20	...	
	3	Residue of castor cake at 10½ cwts. per acre.	4	...	73	33	...	147	26	...	
	4	Residue of castor cake at 10½ cwts. per acre.	4	...	44	37	...	89	34	...	

STATEMENT No. VI.

Showing the residual effects of manure on Senji fodder after cotton in C-2 of square 27.

No. of square.	No. of plot.	Treatment.	ACTUAL AREA.		OUTTURN.			OUTTURN PER ACRE.			REMARKS.
			K.	M.	M.	S.	Ch.	M.	S.	Ch.	
27 C-2	1	Residues of farm yard manure at 15 tons per acre + crude nitre 495 lbs. containing 65 lbs. N. per acre.	4	...	35	6	...	70	12	...	Date of sowing 28th November 1910. Date of harvest 22nd March 1911. Waterings, 4.
	2	Residues of farm yard manure 15 tons per acre + Ca $(NO_3)_2$ 650 lbs. containing 65 lbs. of N. per acre.	4	...	34	8	...	68	16	...	
	3	Residues of farm yard manure 15 tons per acre.	4	...	48	30	...	97	20	...	
	4	Ditto ditto	4	...	36	23	...	73	6	...	

STATEMENT No. VII.

Showing the results of sub-soiling and variety experiments with sugarcane at the Lyallpur Agricultural Station.

No. of square.	No. of plot.	AREA.		Name of variety.	Tillage.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE		WEIGHT OF GUR.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
		Kanals.	Marlas.			Mds.	Sers.	Mds.	Sers.	Mds.	Sers.	Mds.	Sers.					
27	$\frac{A}{1}$ Part.	2	...	Kahee ...	Furrow turning plough.	39	22	63	18	37	36	5	10	62·33	59·73	13·85	8·27	Farm yard manure 16 tons per acre.
27	Do.	2	...	Do. ...	Furrow turning plough plus sub-soiler.	53	1	128	20	61	25	10	11	41·26	47·95	16·67	7·99	
27	$\frac{A}{2}$ Part.	2	...	Dhaulu ...	Furrow turning plough.	20	26	41	5	23	11	4	35	50·21	56·59	20·94	11·85	
27	Do.	2	...	Do. ...	Furrow turning plough plus sub-soiler.	31	37	62	22	31	36	5	6	51·03	50·98	16·14	8·23	

1. Ploughings with furrow turning plough ... ... = 2
2. Sub-soiling centre halves ... ... = 1
3. Harrowings ... ... = 3
4. Weedings and hoeings ... ... = 3 One extra hoeing with spring-toothed harrow in case of Dhaulu.
5. Waterings .. .. = 12

Crushing began in case of Dhaulu on 4th February 1911 and finished on 18th February 1911.

Crushing began in case of Kahee on 14th December 1910 and finished an 31st December 1910.

STATEMENT NO. VIII.

Showing deep cultivation and subsoiling experiment with cotton at the Lyallpur Agricultural Station. Variety—Hansi Cotton.

No. of square.	No. of plot.	Sub-soiled or not.	AREA.		ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.
			Kanals.	Marlas.	Maunds.	Sers.	Chataks.	Maunds.	Sers.	Chataks.	
9	1	Diamond plough ...	3	4	3	29	4	9	12	12½	(1) Ploughings—2.
9	2	Diamond plough and sub-soiler	3	4	3	24	5	9	...	7	(2) Sub-soiling in case of Nos. 2 and 4=1.
9	3	Diamond plough ...	3	4	3	17	1	8	22	5½	(3) Harrowings,—3.
9	4	Diamond plough and sub-soiler	3	4	3	24	1	8	39	13	Weedings and hoeings—3. Waterings—4. Picking began on 23rd September 1910. Finished on 2nd January 1911.

STATEMENT NO. IX.

Different methods of sowing cotton. Variety of cotton—Hansi.

No. of square.	No. of plot.	Method of sowing.	AREA.		OUTTURN.			OUTTURN PER ACRE.			REMARKS.
			Kanals.	Marlas.	Maunds.	Sers.	Chataks.	Maunds.	Sers.	Chataks.	
26/A-2 ...	1	On ridges	6	18	10	25	5	12	13	1	Ploughings—2.
26/A-2 ...	2	On flat	6	18	13	30	1	15	37	11	Harrowings—7. Weedings and Hoeings—7 to 11.
26/A-2 ...	3	On flat and ridged afterwards.	6	18	12	14	9	14	13	15	Ridging in Nos. 1 and 3—Twice in No. 3, five times in No. 1. Waterings—Five to plots 2 and 3 and 7 to plot 1. Picking began on 21st September 1910 and finished on 27th December 1910.

STATEMENT X.

Showing the water requirements of Desi and American cotton.

Square.	Name of variety.	Area of each plot.		Actual outturn.		Outturn per acre.		Number of waterings.	Remarks.
		Kanals.	Marlas.	Maunds.	Sers.	Maunds.	Sers.		
9	Farm selected ...	8	...	4	$16\frac{5}{16}$	4	$16\frac{5}{16}$	4	
9	American 266 F. ...	7	16	6	$29\frac{1}{16}$	6	$35\frac{7}{8}$	5	

STATEMENT XI.

Showing the results of Desi versus *furrow turning plough and also the residual effects of calcium nitrate as a fertilizer to wheat at the Lyallpur Agricultural station.*

MANURED.										UNMANURED.									
	Area.				Outturn per acre.						Area.				Outturn per acre.				Remarks.
					Grain.		Bhusa.								Grain.		Bhusa.		
Square.	Kanals.	Marlas.	Variety of wheat.	Treatment.	Maunds.	Sers.	Maunds.	Sers.	Remarks.	Square.	Kanals.	Marlas.	Variety of wheat.	Treatment.	Maunds.	Sers.	Maunds.	Sers.	
					LIGHT FURROW TURNING PLOUGH.														
29	9	5	Dandkhani of Delhi.	Residues of calcium nitrates at ½ cwt. per acre.	12	23⅓	33	11		29	9	5	Dandkhani of Delhi.	No manure.	12	16½	31	39	Ploughings with Raja plough ... 2 Harrow ... 9 Chain Harrow ... 1 Weedings and hoeings 1 Waterings ... 3
					DESI "MUNNA" PLOUGH.														
29	7	8			13	17⅓	40	29		29	7	8			13	24¾	30	32½	Ploughings with "Munna" plough ... 10 Chain Harrow ... 1 Weedings and hoeings 1 Waterings ... 3

Wheat sown on 6th and 7th December 1910.
Harvested on 5th to 7th May 1911.

STATEMENT No. XII.

Calcium Nitrate experiment with Wheat at the Lyallpur Agricultural Station.

No. of square or plot.	Calcium Nitrate, per acre.	MANURED PLOTS.				UNMANURED PLOTS.				INCREASE PER ACRE OF				INCREASED REVENUE VALUE OF GRAIN Rs. 2-8-0 PER MAUND AND BHUSA AT Rs. 0-4-0 PER MAUND.			EXPENDITURE COST AT Rs. 9-10-9 PER MAUND.			DEFICIT.			REMARKS.
		AVERAGE OUTTURN PER ACRE				AVERAGE OUTTURN PER ACRE.																	
		Of grain.		*Of bhusa.*		*Grain.*		*Bhusa.*		*Grain.*		*Bhusa.*											
		Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	
7/9	112 lbs. ...	11	36	33	32	9	6	28	18	2	30	5	14	8	3	0	13	4	9	5	1	9	
7/8	168 lbs. ...	12	10	35	18	9	16	25	2	2	34	10	16	9	11	7	19	15	2	10	3	7	
13/6	82 lbs. ...	19	4	55	23	17	22	49	14	1	22	6	9	5	6	11	9	10	9	4	3	10	
13/7	Do. ...	23	4	69	25	22	17	63	36	0	27	5	29	3	1	10	9	10	9	6	8	11	
13/8	Do. ...	19	34	50	32	20	28	48	31	0	34	2	1	1	12	0	9	10	9	11	6	9	
13/9	Do. ...	19	11	52	33	18	23	52	3	0	28	0	30	1	15	0	9	10	9	7	11	9	
13/10	Do. ...	23	32	64	7	22	22	51	7	1	10	13	0	6	6	0	9	10	9	3	4	9	

STATEMENT No. XIII.

Showing the results of Dési versus *Raja plough at the Lyallpur Agricultural Station in Rabi,* 1910-11.

RAJA PLOUGH.

No. of square.	No. of plot.	Variety of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		*Bhusa.*		*Grain.*		*Bhusa.*		
			Kanals.	Marlas.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	
12	17	Lal kasar wali ...	4	9	6	21	9	21	11	29	17	5	Ploughings ... 2 Harrowings ... 2 Weeding and hoeing ... 1 Waterings ... 5 Date of sowing, 15th November 1910. Date of harvesting, 21st April 1911.
	18	Ditto ...	4	11	7	13	9	15	12	35	16	19	
		Total ...	...	...	...	...	...	...	24	24	33	24	
7	22	Lal kasar wali ...	3	19	7	17	22	14	15	1	45	10	Ploughings ... 2 Harrowings ... 6 Weeding and hoeing ... 1 Waterings ... 3 Date of sowing, 19th and 25th November 1910. Date of harvesting, 26th and 28th April 1911.
	23	Ditto	4	11	7	31	15	5	13	26	26	24	
	24	Ditto	4	9	5	10	12	2	9	17	21	26	Ploughings ... 2 Harrowings ... 6 Weeding and hoeing ... 1 Waterings ... 3 Date of sowing, 21st November 1910. Date of harvesting, 26th April 1911.
	25	Ditto	4	1	6	22	11	17	12	38	22	22	
		Total ...	...	...	...	..	...	...	51	2	116	2	

DESI PLOUGH.

No. of square.	No. of plot.	Variety of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		*Bhusa.*		*Grain.*		*Bhusa.*		
			Kanals.	Marlas.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	
12	17	Lal kasar wali	4	9	6	20	10	23	11	27	19	0	Ploughings ... 4 Weeding or hoeing 1 Waterings ... 5 Date of sowing, 11th and 15th October 1910. Date of harvesting, 21st April 1911.
	18	Ditto	4	11	6	15	11	25	11	8	20	17	
		Total ...	...	...	...	...	...	...	22	35	39	17	
7	22	Lal kasar wali	3	19	6	29	22	14	13	24	45	10	Ploughings ... 8 Weeding ... 1 Waterings ... 3 Date of sowing, 19th and 25th November 1910. Date of harvesting 26th and 28th April 1911.
	23	Ditto	4	11	8	2	13	16	14	6	23	22	
	24	Ditto	4	9	7	12	13	...	13	3	23	14	Ploughings ... 8 Weedings and hoeings ... 2 Waterings ... 3 Date of sowings, 21st November 1910. Date of harvesting, 26th April 1911.
	25	Ditto	4	1	6	28	11	11	13	9	22	13	
		Total ...	...	...	...	...	...	...	54	2	114	19	

STATEMENT No. XIV.

Showing the results of hot weather versus *rain ploughing at the Lyallpur Agricultural Station in rabi* 1910-11.

HOT WEATHER PLOUGHING.

No. of square.	No. of plot.	Variety of wheat.	Area.		Actual outturn.				Outturn per acre.				Remarks.
					Gram.		*Bhusa.*		*Gram.*		*Bhusa.*		
			Kanals.	Marlas.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	
6	7	Lal Kasarwali.	9	7	17	20	45	22	14	38	38	38	Ploughed on 20th June.
	13	Ditto	8	13	18	10	37	37	16	35	35	3	Ploughed on 24th May.
	9	Ditto	9	2	11	12	31	2	9	37	27	11	Ploughed on 25th May.
	11	Ditto	8	...	12	16	27	7	12	16	27	7	Ploughed on 8th June.
		Total ...	...	...	...	...	...	...	34	6	128	19	

RAIN PLOUGHING.

No. of square.	No. of plot.	Variety of wheat.	Area.		Actual outturn.				Outturn per acre.				Remarks.
					Gram.		*Bhusa.*		*Gram.*		*Bhusa.*		
			Kanals.	Marlas.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	
6	8	Lal Kasarwali.	8	18	10	39	24	12	9	34	21	33	25th July.
	10	Ditto	8	...	13	24	22	23	13	24	22	23	24th July.
	12	Ditto	8	18	14	3	34	6	12	26	30	27	23rd July.
	14	Ditto	9	11	15	28½	31	12½	13	6	26	9	22nd July,
		Total ...	...	...	...	...	...	...	49	10	101	12	

Ploughings 2
Harrowings 6
Weedings and hoeings ... 1
Waterings ... ... 3 to 4
Date of sowing—29th November 1910 and 30th November 1910 25th November 1910 and 26th November 1910.
Date of harvesting 30th April 1911 to 3rd May 1911.

Rain on—

31st May 1910	0·14
5th June 1910	0·15
16th June 1910	2·13
29th June 1910	1·42
21st July 1910	0·63
29th July 1910	1·09

STATEMENT XV.

Showing the result of wheat types grown at the Lyallpur Agricultural Station.

NUMBER OF		AREA.		Number of type.	Previous crop.	DATE OF		OUTTURN OF GRAIN PER ACRE.		OUTTURN OF BHUSA PER ACRE.		REMARKS.
Square.	Plot.	Kanals.	Marlas.			Sowing.	Harvesting.	Maunds.	Sers.	Maunds.	Sers.	
26	$3\frac{A}{4}$	8	...	1	Wheat ...	7th November 1910...	29th April 1911 ...	18	20	51	10	Germination good, tillering good, mostly erect. Rust present.
26	$1\frac{A}{4}$	8	...	9	Do. ...	7th November 1910...	29th April 1911 ...	20	...	48	15	Germination good, tillering good, all erect. Rust present.
26	$2\frac{A}{4}$	8	...	11	Do. ...	7th November 1910...	29th April 1911 ...	20	26	44	24	Germination good, tillered well, ⅔rds lodged. Rust present.
9	23	9	2	4	San ploughed ...	17th November 1910	27th April 1911 ...	11	$5\frac{5}{7}$	27	8	Germination good, tillering fair, erect. Rust present.
26	$2\frac{A}{1}$	8	...	12	Fallow ...	6th November 1910...	25th to 27th April 1911	16	30	68	15	Germination good, tillering good, mostly lodged. Rust present.
26	$3\frac{A}{1}$	8	...	14	Do. ...	6th November 1910...	1st to 3rd May 1911.	21	3	56	4	Germination good, tillering good, badly lodged. Rust present.
26	$1\frac{A}{1}$	8	...	15	Do. ...	6th November 1910...	22nd to 30th April 1911	17	21	75	27	Germination good, tillering good, ⅔rds lodged. Rust present.

Operations for $\frac{A}{1}$

Ploughings ... = 3
Spring toothed Harrow ... = 10
Bullock Hoe ... = 9
Waterings ... = 3
Weedings and hoeings ... = 1

Operations for $\frac{A}{4}$

Ploughings ... = 2
Spring toothed Harrow ... = 12
Bullock Hoe ... = 1
Waterings ... ... = 3 and one extra to type No. 1 *Wadanak.*
Weedings and hoeings ... = 1

STATEMENT No. XVI.

Showing the results of wheat types grown in square 10.

No. of		Area.		Type.	Previous crop.	Outturn per acre.			Remarks.
Square.	Plot.	Kanals.	Marlas.			Maunds.	Sers.	Chattaks.	
10	8, 13, 18, 23	35	7	Type 1 ...	Mash in kharif, 1910.	9	28	...	Growth irregular, suffered through hot winds, grain shrivelled to some extent.
10	6, 15, 16 and 25.	34	18	Do. 9 ...		9	9	...	Growth irregular, grain shrivelled, land mostly uneven.
10	7, 14, 17, 24	35	2	Do. 11 ...		12	20	...	Growth very uneven.

STATEMENT No. XVII.

Showing the outturn of wheat types at the Lyallpur Agricultural Station, grown with tenants, in rabi 1910-11.

Number of		Area.		No. of Type.	Previous crop.	Date of		Outturn of grain per acre.		Type of soil.	Remarks.
Square.	Plot.	Kanals.	Marlas.			Sowing.	Harvesting.	Maunds.	Sers.		
16	13	8	18	1	Wheat ...	15th November 1910 ...	27th April 1911 ...	10	18	Heavy loam ...	Germination good, tillering fair, badly rusted, all standing.
17	24	8	18	5	Do. ...	11th November 1910. ...	20th April 1911 ...	14	19	Do. ...	Germination good, tillered very well, mostly slanting, intensely rusted.
...	23	9	2	6	Do. ...	Do. ...	Ditto ...	13	7	Do. ...	Germination good, tillered very well, mostly standing, badly rusted.
...	14	9	2	7	Do. ...	4th December 1910 ...	28th April 1911 ...	10	1	Do. ...	Erect, tillered very well, rust bad.
...	18	8	18	8	Do. ...	10th February 1910 ...	2nd May 1911 ...	6	24	Do. ...	Germination good, tillered well, rust in traces, sown late, grain shrivelled through hot winds.
11	21, 7	16	13	9	Do. ...	29th November 1910 ...	Ditto ...	10	35	Loam ...	Germination good, tillering good, all standing, rust in traces.
	22	8	14	9	Do. ...	30th November 1910 ...	Ditto ...	12	32	Do. ...	
	23	8	...	9	Do. ...	15th November 1910 ...	Ditto ...	18	9	Do. ...	
3	12, 9. 2, 19	37	15	9	Do. ...	21st November 1910 to 2nd December 1910.	30th April 1911 ...	9	1	Sandy loam with kallar patches.	Ditto ditto.
1	5	2	4	9	Do. ...	19th November 1910 ...	25th April 1911 ...	6	36	Loam and sandy.	
	6, 7, 14, 13, 24	29	10	9	Do. ...	20th November 1910 to 26th November 1910 and 9th December 1910 to 10th December 1910.	25th April 1911 to 4th May 1911.	4	37		Germination good, tillered well, all standing. Grain badly shrivelled.
8	8	9	11	10	Do. ...	8th November 1910 ...	23rd April 1911 ...	11	9	Sandy loam ...	Germination satisfactory, tillering fair, badly lodged, rust present.
3	16, 17, 18, 13, 14, 8	43	9	11	Do. ...	3rd November 1910 to 10th November 1910.	25th April 1911 to 3rd May 1911.	16	23	Loam ...	Germination good, tillering good, ⅔rds lodged, rust present.

9	2, 3, 4, 5 and 20	34	13	11	Do. ...	18th November 1910 to 20th November 1910 and on 8th December 1910.	25th April 1911 to 5th May 1911.	13	39	Calcareous loam	Germination good, tillering good, erect, rust present.
8	9 and 10	14	7	11	Do. ...	20th November 1910 to 21st November 1910.	25th April 1911 ...	9	4	Sandy loam ...	Ditto ditto.
13	14	8	13	12	Do. ...	15th November 1910 ...	20th April 1911 ...	13	9	Clayey loam ...	Germination good, tillering good, badly lodged, and badly rusted.
9	6	7	11	13	Barley ...	8th November 1910 ...	25th April 1911 ...	8	14	Calcareous loam	Germination good, tillering poor, erect, rust present.
12	4	8	4	14	Wheat ...	2nd December 1910 ...	2nd May 1911 ...	14	25	Loam with kallar patches.	Germination good, tillered well, ¼th lodged, rust in traces.
...	17	9	2	15	Do. ...	10th November 1910 ...	22nd April 1911 ...	17	10	Heavy loam ...	Germination good, tillered well, badly lodged, intensely rusted.
6	1	8	...	16	Cotton ...	27th December 1910 ...	30th April 1911 ...	9	20	Calcareous loam with patches of kallar.	Germination good, tillering fiar, erect, rust in traces.
...	2	9	2	17	Do. ...	9th November 1910 ...	22nd April 1911 ...	13	26	Calcareous loam	Germination good, tillering fair, erect, badly rusted.
...	6	8	18	18	Wheat ...	12th December 1910 ...	4th May 1911 ...	9	1	Do.	Germination, tillering good, all standing, rust in traces.
7	7	8	18	19	Do. ...	Do. ...	Do. ...	5	27	Calcareous with patches.	Germination good, tillering fair, all standing, rust in traces.
...	7	8	18	20	Barley ...	7th November 1910 ...	25th April 1911 ...	10	...	Calcareous loam	Germination good, erect, rust present, tillering fair.
...	3	8	4	21	Wheat ...	2nd December 1910 ...	22nd April 1911 ...	12	25	Loam, kallar patches.	Germination good, tillering good, mostly erect, rust present.
1	21, 22	5	19	22	Do. ...	10th December 1910 ...	1st May 1911 ...	5	36	Loam ...	Germination good, tillering good, erect, rust in traces, grain badly shrivelled through hot winds.
...	22, 19	6	16	23	Do. ...	Ditto ...	Do. ...	8	12	Do. ...	Ditto ditto.
...	13	9	2	24	Melons ..	7th December 1910 ...	25th April 1911 ...	8	34	Sandy loam ...	Germination good, tillered well, erect, rust in traces.
11	24	9	7	25	Toria ...	15th November 1910 ...	21st April 1911 ...	17	36	Loam ...	Germination good, tillering good, ¾ths lodged, rust present.
11	17	8	18	Pusa No. 1	Wheat ...	16th November 1910 ...	27th April 1911 ...	14	8	Sandy loam ...	Germination good, tillering fair, condition average, all standing, rust present.

STATEMENT A—COTTONS.

Area in acres.	No. of variety.	Name of variety.	Outturn per acre.		Percentage of lint to cotton.	Length of lint in inches.	Remarks.
			Maunds.	Sers.			
$\frac{1}{8}$	1 F.	Dharwar American	14	9	30	1	
$\frac{1}{8}$	4 F.	Ditto	12	21	33	1	
$\frac{1}{8}$	7 F.	Ditto	12	11	33	·9	
$\frac{1}{8}$	8 F.	Ditto	10	36	33	1	Bushes undersized, not well watered.
$\frac{1}{18}$	14 F.	Ditto	13	19	32	·9	
$\frac{1}{18}$	19 F.	Ditto	11	23	26	·9	Alkali land.
$\frac{1}{138}$	67 F.	Ditto	15	33	33	·9	
$\frac{1}{18}$	91 F.	Ditto	12	22	26	1	
...	102 F.	Ditto	10	36	27	·9	
$\frac{1}{18}$	106 F.	Ditto	10	26	33	·9	
$\frac{1}{18}$	110 F.	Ditto	9	15	33	1	
$\frac{1}{18}$	111 F.	Ditto	11	2	33	·9	
$\frac{1}{18}$	112 F.	Ditto	9	13	33	1	
$\frac{1}{8}$	113 F.	Ditto	11	1	33	1	
$\frac{1}{8}$	126 F.	Ditto	14	2	35	1	
$\frac{1}{8}$	161 A. F.	Lyallpur American	11	35	29	1·1	Lint very fine and silky.
$\frac{1}{138}$	168 F.	Dharwar American	13	12	27	·9 to 1	Bolls open specially well.
$\frac{1}{8}$	179 F.	Ditto	12	3	25	1	Ripens two weeks earlier than others.
$\frac{1}{8}$	199 F.	Ditto	11	8	31	1	
$\frac{1}{18}$	211 F.	Ditto	10	30	32	·9	
$\frac{1}{18}$	226 F.	Ditto	11	34	27	1	Large bolls.
$\frac{1}{8}$	230 F.	Ditto	12	29	34	1	Rather late.
$\frac{1}{18}$	232 F.	Ditto	11	20	26	·9	Ditto.
$\frac{1}{18}$	233 F.	Ditto	12	20	35	·9	Large bolls.
$\frac{1}{18}$	235 F.	Ditto	10	26	33	·9	
$\frac{1}{18}$	241 F.	Ditto	10	8	36	·9	Early ripening.
$\frac{1}{18}$	246 F.	Ditto	9	32	27	·9	
$\frac{1}{69}$	248 F.	Ditto	8	10	33	·9	
$\frac{1}{8}$	266 F.	Punjab Narma	10	...	33	·9	
$\frac{5}{138}$	267 F.	Dharwar American	14	37	33	·9	
$\frac{1}{8}$	270 F.	Punjab Narma	10	35	32	·9	
		INDIGENOUS COTTONS.					
$\frac{1}{8}$	29	Lyallpur desi	15	12	33	·6	
$\frac{1}{8}$	28	F. S. Broad leaved	17	6	33	·6	
$\frac{1}{8}$	28	F. S. Narrow leaved	14	30	33	·6	

STATEMENT B.

Australian Wheats.

Area in acre.	Name of variety.	Date of			Outturn per acre in 1911.				Outturn per acre in 1910.		Outturn per acre in 1909.		Condition of the standing crop in 1911.			Remarks.
		Sowing.	Earing.	Ripening.	*Grain.*		*Straw.*		*Grain.*		*Grain.*		*Area in acre (and height of crop.)*			
					Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Good.	Medium.	Poor.	
$\frac{1}{16}$	Jonathan ...	9th November 1910	19th March 1911...	28th April 1911 ...	13	11	68	24	15	24	19	9	$\frac{1}{16}$ (5′)	...	...	Germination regular; tillering fair; slightly attacked by rust; soil poor; rejected.
$\frac{1}{16}$	Bunyip ...	Ditto	22nd February 1911	17th April 1911 ...	15	1	66	20	22	16	16	10	$\frac{1}{16}$ (4′)	...	...	Germination regular; tillering fair; rust very bad; reh (alkali) in soil; rejected.
$\frac{1}{16}$	Laidly ...	Ditto	22nd March 1911	26th April 1911 ...	9	22	70	24	16	0	19	4	$\frac{1}{24}$ (3¾′)	$\frac{1}{48}$ (4½′)	...	Germination regular; tillering good; slightly attacked by rust; badly damaged by birds; reh (alkali) in soil; rejected.
$\frac{1}{16}$	Velvet Don ...	Ditto	Ditto	28th April 1911 ...	7	32	64	0	14	0	19	21	$\frac{3}{80}$ (5′)	$\frac{1}{40}$ (4½′)	...	Germination regular; tillering good; slightly attacked by rust; badly damaged by birds; reh (alkali in soil; rejected.
$\frac{1}{16}$	Gluya's Early ...	Ditto	Ditto	18th April 1911 ...	20	23	54	32	19	8	20	20	$\frac{7}{240}$ (4′)	$\frac{1}{30}$ (3¾′)	...	Germination regular; tillering fair; slightly attacked by rust; reh alkali) in soil.
$\frac{1}{16}$	Comeback ...	Ditto	26th February 1911	19th April 1911 ...	17	15	57	32	18	16	23	36	$\frac{7}{240}$ (4′)	$\frac{1}{30}$ (3¾′)	...	Germination regular; tillering fair; rust very bad.
$\frac{1}{12}$	Lal Kale Kasarwali (standard).	Ditto	5th March 1911 ...	23rd April 1911 ...	20	28	35	24	...	...	...	...	$\frac{7}{480}$ (4½′)	$\frac{1}{60}$ (4′)	...	Germination regular; tillering good; badly affected by rust.
$\frac{1}{16}$	Bancraft ...	Ditto	16th March 1911...	29th April 1911 ...	14	10	39	8	22	32	21	39	...	$\frac{13}{480}$ (4½)	$\frac{17}{480}$ (4′)	Germination regular; tillering fair; rust bad; reh (alkali) in soil.

STATEMENT B—concluded.

Area in acre.	Name of variety.	Date of			Outturn per acre in 1911.				Outturn per acre. in 1910.		Outturn per acre in 1909.		Condition of the standing crop in 1911.			Remarks.
					Grain.		Straw.		Grain.		Grain.		Area in acre (and height of crop.)			
		Sowing.	Earing.	Ripening.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Good.	Medium.	Poor.	
$\frac{1}{16}$	Jumbuck ...	9th November 1910	22nd March 1911...	30th April 1911 ...	7	39	38	24	15	16	16	39	...	$\frac{1}{48}$ (4′)	$\frac{1}{24}$ (3½′)	Germination regular; tillering good; reh (alkali) in soil; rust bad; stunted growth; rejected.
$\frac{1}{16}$	Saragola ...	Ditto	Ditto ...	Ditto ...	11	4	29	24	11	16	16	31	...	$\frac{11}{480}$ (5½′)	$\frac{10}{480}$ (5′)	Germination regular; tillering good; rust bad; reh (alkali) in soil; badly damaged by birds; rejected.
$\frac{1}{16}$	Medeah ...	Ditto	16th March 1911...	Ditto ...	7	32	33	16	19	16	16	31	...	$\frac{1}{48}$ (5½′)	$\frac{1}{24}$ (5′)	Germination regular; tillering poor; slightly affected by rust; reh (alkali) in soil; very badly damaged by birds.
$\frac{1}{16}$	Budd's Early ...	Ditto	12th March 1911...	Ditto ...	10	30	36	8	20	32	15	33	...	$\frac{3}{160}$ (5′)	$\frac{7}{160}$ (4½′)	Germination regular; tillering good; rust bad; reh (alkali) in soil; rejected.
$\frac{1}{16}$	Federation ...	Ditto	10th March 1911...	28th April 1911 ...	13	11	27	16	16	0	13	22	...	...	$\frac{1}{16}$ (3½′)	Germination regular; tillering good; rust rather bad; reh (alkali) in soil; straw of stunted growth; rejected.
$\frac{1}{16}$	Farrer's Durum ...	Ditto	14th March 1911...	29th April 1911 ...	4	26	27	16	12	16	15	9	...	...	$\frac{1}{16}$ (3¾′)	Germination regular; tillering good; slightly attacked by rust; reh (alkali) in soil; straw of stunted growth; eaten up by birds; rejected.

$\frac{1}{16}$	Kulumka ...	Ditto	22nd March 1911...	30th April 1911 ...	5	11	39	0	14	0	14	32	...	$\frac{1}{16}$ (5½′)	...	Germination regular; tillering good; slightly attacked by rust; eaten up by birds; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	5th March 1911 ...	23rd April 1911 ...	17	23	43	24	...	...	...	...	...	$\frac{7}{32}$ (4¼)	...	Germination regular; tillering fair; rust-affected grains.
$\frac{1}{16}$	Hudson's Early ...	Ditto	19th March 1911...	24th April 1911 ...	13	19	49	24	21	24	14	32	$\frac{1}{16}$ (4½′)	...	...	Germination regular; tillering good; rust bad.
$\frac{1}{16}$	Creton ...	Ditto	18th March 1911...	3rd May 1911 ...	8	32	56	24	8	16	14	18	$\frac{1}{16}$ 5′)	...	...	Germination regular; tillering good; slightly attacked by rust; damaged by birds; rejected.
$\frac{1}{16}$	John Brown ...	Ditto	19th March 1911...	28th April 1911 ...	19	21	85	8	22	16	14	18	$\frac{1}{16}$ (4½′ ,	...	...	Germination regular; tillering fair; rust bad.
$\frac{1}{16}$	Belatourka ...	Ditto	22nd March 1911...	3rd May 1911 ...	11	21	68	32	16	0	13	5	$\frac{1}{16}$ (5′)	...	...	Germination thin; tillering good; slightly attacked by rust; damaged by birds; rejected.
$\frac{1}{16}$	F. R. Macaroni ...	Ditto	Ditto ...	Ditto ...	13	11	71	16	19	8	11	32	$\frac{1}{16}$ (5½′)	...	...	Germination regular; tillering good; rust bad; badly damaged by birds; rejected.
$\frac{1}{16}$	Sunset I sowing ...	Ditto	22nd February 1911	10th April 1911 ...	18	30	47	24	15	16	13	11	$\frac{1}{16}$ 3¾′)	...	...	Germination regular; tillering poor; rust bad; attacked by rats.
$\frac{1}{32}$	Lal Kale Kasarwali (Standard).	Ditto	5th March 1911 ...	23rd April 1911 ...	25	0	86	0	...	...	...	...	$\frac{1}{32}$ (4½′)	...	...	Germination regular; tillering fair; rust very bad; whole area lodged.
$\frac{1}{16}$	Sunset II sowing ...	24th December 1910	25th February 1911	20th April 1911 ...	4	12	25	8	9	24	2	14	...	...	$\frac{1}{32}$ (3′)	Germination regular; tillering fair; rust bad; attacked by rats.
$\frac{1}{16}$	Sunset III sowing ...	29th December 1911	29th February 1911	Ditto ...	3	37	15	8	6	0	0	32	...	...	$\frac{1}{32}$ (3′)	Germination regular; tillering fair; rust bad; attacked by rats.

STATEMENT C.

Indigenous Wheats.

Area in acre.	Name of variety.	DATE OF			OUTTURN PER ACRE IN 1911.				OUTTURN PER ACRE IN 1910.		OUTTURN PER ACRE IN 1909.		CONDITION OF THE STANDING CROP IN 1911.			REMARKS.
					Grain.		*Straw.*		*Grain.*		*Grain.*		*Area in acre (and height of crop).*			
		Sowing.	Earing.	Ripening.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Good.	Medium.	Poor.	
	1.—MACARONI WHEATS (WADANAKS).															
$\frac{1}{16}$	Palestine of Lahore ...	8th November 1910	11th March 1911...	25th April 1911 ...	12	23	44	24	14	32	19	13	$\frac{3}{80}$ (5¼′)	$\frac{1}{40}$ (5′)	...	Germination thin; tillering fair; rust bad; badly lodged; type No. I; rejected.
	2.—COMMON WHEATS, BEARDLESS WHEATS WITH RED GLUMES AND WHITE GRAINS.															
$\frac{1}{8}$	Stray No. 1 ...	8th November 1910	26th February 1911	18th April 1911 ...	16	24	62	8	18	32	27	13	$\frac{1}{8}$ (4¼′)	...	...	Germination thin; tillering good; rust bad; whole area lodged; Punjab type No. 18; rejected.
$\frac{1}{16}$	" " 4 ...	Ditto	27th February 1911	Ditto ...	19	13	77	0	25	24	27	13	$\frac{1}{16}$ (4¼′)	...	...	Germination regular; tillering fair; rust bad; badly lodged; Punjab type No. 18.
$\frac{1}{16}$	" " 5 ...	Ditto	26th February 1911	17th April 1911 ...	19	37	70	0	20	16	20	12	$\frac{1}{16}$ (4′)	...	...	Germination regular; tillering fair; rust very bad; whole area lodged; Punjab type No. 17; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	2nd March 1911 ...	22nd April 1911 ...	23	1	82	16	...	...	...	...	$\frac{1}{32}$ (4¼′)	...	...	Germination regular; tillering fair; rust bad; very little lodging.
$\frac{1}{8}$	Stray No. 6 ...	Ditto	26th February 1911	24th April 1911 ...	19	13	70	16	25	0	32	0	$\frac{1}{8}$ (4′)	...	...	Germination regular; tillering fair; rust bad; crop lodged throughout the plot; type undecided.
$\frac{1}{8}$	" " $\frac{33}{55}$ ...	Ditto	24th February 1911	19th April 1911 ...	18	34	69	20	19	24	33	7	$\frac{1}{8}$ (4′)	...	...	Germination regular; tillering fair; rust bad; crop lodged throughout the plot; Punjab type No. 18; rejected.
$\frac{1}{16}$	" " 38 ...	Ditto	23rd February 1911	24th April 1911 ...	16	8	71	24	17	4	32	0	$\frac{1}{16}$ (4′)	...	...	Germination thin; tillering good; rust bad; ⅛ area lodged; type undecided.
$\frac{1}{16}$	" " 40 ...	Ditto	15th March 1911...	29th April 1911 ...	12	12	72	0	19	32	22	10	$\frac{1}{16}$ (4′)	...	...	Germination thin; tillering good; rust bad; $\frac{1}{16}$ area lodged; Punjab type No. 20; rejected.

$\frac{1}{16}$	" " 49 ...	Ditto	10th March 1911...	26th April 1911 ...	13	3	82	32	28	32	26	22	$\frac{1}{16}$ (4')	...	...	Germination regular; tillering fair; rust bad; ¼ area lodged; Punjab type No. 20.
$\frac{1}{16}$	" " 51 ...	Ditto	16th March 1911...	29th April 1911 ...	13	11	87	32	22	16	22	25	$\frac{1}{16}$ (4½')	...	...	Germination regular; tillering fair; rust very bad; type undecided.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	2nd March 1911 ...	22nd April 1911 ...	19	5	22	32	...	...	...	...	$\frac{1}{32}$ (4½')	...	...	Germination regular; tillering fair; rust bad; very little lodging.
$\frac{1}{16}$	Stray No. 56 ...	Ditto	27th February 1911	24th April 1911 ...	16	8	71	24	24	32	29	11	$\frac{1}{16}$ (4')	...	...	Germination regular; tillering fair; rust very bad; whole area lodged; type undecided.
$\frac{1}{16}$	" " 59 ...	Ditto	24th February 1911	22nd April 1911 ...	18	14	82	16	21	8	21	3	$\frac{1}{16}$ (3¾')	...	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab type No. 21; rejected.
$\frac{1}{8}$	" " 61 ...	Ditto	20th February 1911	18th April 1911 ...	20	39	65	16	23	24	31	25	$\frac{1}{8}$ (4')	...	...	Germination thin; tillering good; rust very bad; whole area lodged; Punjab type No. 17; rejected.
$\frac{1}{16}$	" " 62 ...	Ditto	21st February 1911	22nd April 1911 ...	22	2	87	16	25	24	24	6	$\frac{1}{16}$ (4¼')	...	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab type No. 22; rejected.
$\frac{1}{16}$	" " 67 ...	Ditto	18th February 1911	17th April 1911 ...	26	6	73	0	25	24	29	26	$\frac{1}{16}$ (4')	...	...	Germination regular; tillering poor; rust bad; $\frac{1}{20}$ area lodged; Punjab type No. 17.
$\frac{1}{16}$	" " 68 ...	Ditto	24th February 1911	18th April 1911 ...	22	2	87	16	20	32	29	35	$\frac{1}{16}$ (4')	...	...	Germination regular; tillering poor; rust bad; whole area lodged; Punjab type No. 18.
$\frac{1}{16}$	" " 70 ...	Ditto	21st February 1911	17th April 1911 ...	22	18	76	24	32	0	28	4	$\frac{1}{16}$ (3¾')	...	...	Germination regular; tillering fair; rust very bad; whole area lodged; Punjab type No. 17; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	2nd March 1911 ...	22nd April 1911 ...	29	22	96	0	...	...	...	...	$\frac{1}{32}$ (4')	...	...	Germination regular; tillering fair; rust bad; very little lodging.
$\frac{1}{16}$	Stray No. 71 ...	Ditto	20th February 1911	17th April 1911 ...	20	20	84	16	20	32	22	4	$\frac{1}{16}$ (4')	...	...	Germination regular; tillering poor; rust bad; whole area lodged; Punjab type No. 17; rejected.
$\frac{1}{16}$	" " 88 ...	Ditto	Ditto	22nd April 1911 ...	20	28	77	8	28	32	20	11	$\frac{1}{16}$ (4')	...	...	Germination regular; tillering poor; rust bad; whole area lodged; type undecided.
	3. BEARDLESS WHEATS WITH WHITE GLUMES AND WHITE GRAINS.															
$\frac{1}{16}$	Stray No. $\frac{77}{B}$ ...	8th November 1910	21st February 1911	24th April 1911 ...	20	12	83	24	35	8	22	25	$\frac{1}{30}$ (4½')	$\frac{7}{240}$ (4¼')	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab types Nos. 24 and 25; rejected.
$\frac{1}{16}$	" " 78 ...	Ditto	20th February 1911	Ditto ...	22	10	78	0	24	16	26	37	$\frac{1}{16}$ (4½')	...	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab type undecided.
$\frac{1}{16}$	" " 79 ...	Ditto	23rd February 1911	25th April 1911 ...	16	0	71	16	35	8	20	27	$\frac{1}{16}$ (4¼')	...	...	Germination regular; tillering fair; rust very bad; whole area lodged; Punjab type No. 17; rejected.

STATEMENT C—*concluded.*

Area in acre.	Name of variety.	Date of			Outturn per acre in 1911.				Outturn per acre in 1910.		Outturn per acre in 1909.		Condition of the standing crop in 1911.			Remarks.
					Grain.		*Straw.*		*Grain.*		*Grain.*		*Area in acre (and height of crop).*			
		Sowing.	Earing.	Ripening.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Good.	Medium.	Poor.	
	3. BEARDLESS WHEATS WITH WHITE GLUMES AND WHITE GRAINS—*concluded.*															
$\frac{1}{16}$	Stray No. 80 ...	8th November 1910	23rd February 1911	24th April 1911 ...	18	30	73	24	30	16	21	34	$\frac{1}{16}$ (4½′)	...	...	Germination regular; tillering fair; rust very bad; whole area lodged; Punjab type undecided.
$\frac{1}{16}$	" " 85 ...	Ditto	24th February 1911	25th April 1911 ...	16	16	59	8	25	8	22	25	$\frac{1}{16}$ (4½′)	...	...	Germination regular; tillering good; rust very bad; whole area lodged; Punjab types Nos. 24 and 25; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	28th February 1911	22nd April 1911 ...	32	0	103	8	...	...	...	...	$\frac{1}{32}$ (4½′)	...	...	Border; germination irregular; tillering fair; rust bad; whole area lodged.
$\frac{1}{32}$	Ditto	Ditto	27th February 1911	Ditto ...	30	2	84	0	...	...	...	...	$\frac{1}{32}$ (4½′)	...	...	Border; germination regular; tillering fair; rust bad; whole area lodged.
$\frac{1}{16}$	Stray No. 96 ...	Ditto	24th February 1911	20th April 1911 ...	30	26	89	8	36	32	23	32	$\frac{1}{16}$ (4½′)	...	...	Germination regular; tillering good; rust bad; half area lodged; Punjab types Nos. 24 and 25; rejected.
$\frac{1}{16}$	" " 98 ...	Ditto	22nd February 1911	Ditto ...	23	9	72	16	33	24	26	39	$\frac{1}{16}$ (4¼′)	...	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab type No. 25; rejected.
$\frac{1}{16}$	" " 102 ...	Ditto	27th February 1911	29th April 1911 ...	24	0	89	8	26	16	20	17	$\frac{1}{16}$ (4¼′)	...	...	Germination regular; tillering fair; rust very bad; half area lodged; Punjab type No. 24.
$\frac{1}{16}$	" " 104 ...	Ditto	2nd March 1911 ...	20th April 1911 ...	20	0	74	24	27	16	24	8	$\frac{1}{16}$ (4′)	...	...	Germination regular; tillering good; rust very bad; half area lodged; Punjab type No. 24; rejected.
$\frac{1}{16}$	" " 105 ...	Ditto	25th February 1911	Ditto ...	17	15	55	32	27	24	19	20	$\frac{1}{16}$ (4′)	...	...	Germination regular; tillering fair; rust very bad; half area lodged; Punjab type undecided.
$\frac{1}{16}$	" " 107 ...	Ditto	27th February 1911	Ditto ...	17	23	59	0	24	16	24	8	$\frac{1}{16}$ (4′)	...	...	Germination regular; tillering fair; rust bad; one-tenth area lodged; Punjab type No. 25; rejected.
	4. BEARDED COMMON WHEATS WITH FELTED GLUMES AND RED GRAINS.															
$\frac{1}{16}$	Stray No. 109 ...	8th November 1910	4th March 1911 ...	23rd April 1911 ...	18	38	70	24	19	32	20	4	$\frac{1}{30}$ (4½′)	$\frac{7}{240}$ (4¼′)	...	Germination regular; tillering poor; rust bad; very little lodging; Punjab type No. 9; rejected.

	5. BEARDED COMMON WHEATS WITH SMOOTH GLUMES AND RED GRAINS.															
$\frac{1}{16}$	Stray No. 47 ...	8th November 1910	26th February 1911	19th April 1911 ...	20	36	71	24	23	24	20	2	$\frac{1}{16}$ (3¾′)	...	...	Germination regular; tillering fair; half area lodged; rust bad; Punjab type No. 14; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	4th March 1911 ...	22nd April 1911 ...	26	22	78	16	...	...	...	...	$\frac{1}{32}$ (4½′)	...	...	Germination regular; tillering fair; rust very bad; Punjab type No. 9.
$\frac{3}{16}$	Lal of Karnal ...	Ditto	26th February 1911	29th April 1911 ...	17	18	71	6	21	12	13	10	$\frac{3}{16}$ (4′)	...	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab type No. 14; rejected.
$\frac{3}{16}$	Lal of Sialkot ...	Ditto	2nd March 1911 ...	22nd April 1911 ...	15	22	71	24	13	12	16	31	$\frac{3}{16}$ (4½′)	...	...	Germination regular but thin; tillering good; rust bad; whole area lodged; Punjab type No. 14; rejected.
$\frac{3}{16}$	Lal of Attock ...	Ditto	Ditto ...	Ditto ...	16	37	77	14	14	8	12	19	$\frac{3}{16}$ (4)	...	...	Germination regular; tillering fair; rust bad; whole area lodged; Punjab type No. 15; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	4th March 1911 ...	Ditto ...	26	6	78	16	...	...	...	...	$\frac{1}{32}$ (4½′)	...	...	Germination regular; tillering fair; rust bad.
$\frac{3}{16}$	Lal of Sirsa ...	Ditto	26th February 1911	Ditto ...	15	12	67	8	23	4	16	31	$\frac{3}{16}$ (4½′)	...	...	Germination regular but thin; tillering good; rust bad; whole area lodged; Punjab type No. 14; rejected.
$\frac{3}{16}$	Lal of Zira ...	Ditto	Ditto ...	Ditto ...	16	37	75	3	32	0	14	33	$\frac{3}{16}$ (4½′)	...	...	Germination regular but thin; tillering good; rust bad; whole area lodged; Punjab type No. 14; rejected.
$\frac{3}{16}$	Kasalu or Surkh of Ferozepore.	Ditto	2nd March 1911 ...	20th April 1911 ...	16	21	71	3	22	29	18	29	$\frac{3}{16}$ (4¼′)	...	...	Germination regular but thin; tillering good; rust bad; whole area lodged; Punjab type No. 14; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard.)	Ditto	4th March 1911 ...	22nd April 1911 ...	27	29	77	24	...	...	...	...	$\frac{1}{32}$ (4¼′)	...	...	Germination regular; tillering good; rust very bad; very little lodging.
$\frac{3}{16}$	Lal of Ludhiana ...	Ditto	21st February 1911	Ditto ...	19	31	66	24	24	10	22	9	$\frac{3}{16}$ (4′)	...	...	Germination regular; tillering good; rust bad; half area lodged; Punjab type No. 15; rejected.
$\frac{3}{16}$	Desi Surkh of Jullundur	Ditto	26th February 1911	Ditto ...	17	8	53	27	16	9	21	34	$\frac{3}{16}$ (4′)	...	...	Grmination regular; tillering fair; rust bad; half area lodged; Punjab type No. 15; rejected.
$\frac{3}{16}$	Lal of Jhelum ...	Ditto	Ditto	Ditto ...	17	0	68	3	19	35	22	9	$\frac{3}{16}$ (4′)	...	...	Germination regular; tillering fair; rust bad; half area lodged; Punjab type No. 15; rejected.
$\frac{1}{32}$	Lal Kale Kasarwali (standard).	Ditto	4th March 1911 ...	Ditto ...	22	26	42	32	...	...	...	...	$\frac{1}{32}$ (4½′)	...	...	Germination regular; tillering fair; rust bad.
$\frac{3}{16}$	Lal of Rawalpindi ...	Ditto	6th March 1911 ...	Ditto ...	17	18	73	3	19	27	18	13	$\frac{3}{16}$ (4′)	...	...	Germination regular; tillering good; rust bad; ¼ area lodged; Punjab type No. 15; rejected.

STATEMENT D.

Punjab classified Wheats.

Area in acre.	No. of type.	Name of variety.	Date of			Outturn per acre in 1911.				Outturn per acre in 1910.		Outturn per acre in 1909.		Condition of the standing crop in 1911.			Remarks.
						Grain.		*Straw.*		*Grain.*		*Grain.*		*Area in acre (and (height of crop.)*			
			Sowing.	Earing.	Ripening.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Maunds.	Sers.	Good.	Medium.	Poor.	
																	Border.
$\frac{1}{32}$	IX	Lal Kale Kasarwali standard) ...	7th November 1910.	6th March 1911	22nd April 1911	21	35	82	32	...	...	...	...	$\frac{1}{32}$ ($4\frac{1}{2}'$)	...	...	Germination regular; tillering fair; slightly attacked by rust; the crop lodged throughout the plot.
$\frac{1}{12}$	I	Wadanak of Zira, Sialkot, Batala, Montgomery, Amritsar, Ferozepore; Dagar of Dera Ghazi Khan, Shahpur, Muzaffargarh, Multan, Lyallpur; Palestine of Lahore.	7th November 1910.	10th March 1911	26th April 1911	15	39	73	38	9	20	18	33	$\frac{1}{12}$ ($5\frac{1}{2}'$)	...	...	Germination regular; tillering fair; rust bad; the crop lodged throughout the plot.
$\frac{1}{12}$	II	Stray in Wadanak Kalchunghari of Montgomery.	7th November 1910.	10th March 1911	26th April 1911	10	4	73	20	9	8	31	16	$\frac{1}{12}$ ($5\frac{1}{4}'$)	...	...	Germination regular; tillering fair; rust bad; the crop lodged throughout the plot.
$\frac{1}{12}$	III	Stray in Wadanak of Lyallpur ...	7th November 1910.	10th March 1911	26th April 1911	16	16	69	36	9	20	23	16	$\frac{1}{12}$ ($4\frac{1}{2}'$)	...	...	Germination regular; tillering fair; rust bad; the crop lodged throughout the plot.
$\frac{1}{12}$	IV	Makki of Chiniot	7th November 1910.	24th February 1911.	23rd April 1911	16	10	70	14	21	8	41	18	$\frac{1}{12}$ ($3\frac{1}{4}'$)	...	...	Germination regular; tillering good; rust bad; the crop lodged throughout the plot.
$\frac{1}{12}$	V	Found in Makkawali of Dera Ghazi Khan.	7th November 1910.	26th February 1911.	23rd April 1911	14	38	61	8	19	36	27	12	$\frac{1}{12}$ ($3\frac{1}{4}'$)	...	...	Germination thin; tillering good; rust bad; the crop lodged throughout the plot.
$\frac{1}{12}$	VI	Stray in Makini of Multan ...	7th November 1910.	26th February 1911.	24th April 1911	15	33	70	10	17	0	23	17	$\frac{1}{12}$ ($3\frac{3}{4}'$)	...	...	Germination regular; tillering good; rust very bad; very little lodging.
$\frac{1}{32}$	IX	Lal Kale Kasarwali (standard) ...	7th November 1910.	8th March 1911	22nd April 1911	22	10	72	0	...	...	...	...	$\frac{1}{32}$ ($4\frac{1}{2}'$)	...	...	Germination regular; tillering fair; slightly attacked by rust; the crop lodged throughout the plot.

$\frac{1}{12}$	VII	Common dwarf wheat; Rodi of Shahpur; Rangrihor Ghiali of Kangra; Makini of Multan; Daudi of Muzaffargarh; Daudon of Multan; Makkawali of Dera Ghazi Khan; and Daudi of Multan.	7th November 1910.	26th February 1911.	24th April 1911	16	34	71	28	18	0	27	32	$\frac{1}{12}$ (3¾′)	...	...	Germination regular; tillering fair; slightly attacked by rust; about ½ area lodged.
$\frac{1}{12}$	VIII	Stray in Lal Kasarwali of Lyallpur ...	7th November 1910.	5th March 1911	24th April 1911	18	0	85	14	21	8	21	36	$\frac{1}{12}$ (4¼′)	...	...	Germination regular; tillering fair; rust very bad; the crop lodged throughout the plot.
$\frac{1}{12}$	IX	Found in Lal of Batala; Ratti of Montgomery; Lal Kale Kasarwali of Lyallpur; Lal Desi of Jhelum; Lal of Delhi; Pamman of Ferozepore; Dagar of Multan; Kunjhari of Multan.	7th November 1910.	3rd March 1911	23rd April 1911	20	14	84	36	20	8	34	13	$\frac{1}{12}$ (4½′)	...	...	Germination regular; tillering fair; rust bad; about ½ area lodged.
$\frac{1}{12}$	X	Found in Sufed of Moga; No. 4 Punjab old; Mundi of Ludhiana; and Jogi of Karnal.	7th November 1910.	23rd February 1911.	24th April 1911	12	18	57	8	20	4	21	3	$\frac{1}{12}$ (4)	...	...	Germination regular; tillering poor; slightly attacked by rust. The crop lodged throughout the plot.
$\frac{1}{12}$	XI	Found in Sufed of Amritsar; Sahon of Chiniot; Kunjhari of Dera Ghazi Khan; Daudi of Lyallpur; and Jogi of Karnal.	7th November 1910.	25th February 1911.	24th April 1911	17	17	66	36	22	0	29	26	...	$\frac{1}{12}$ (4′)	...	Germination regular; tillering poor; very slightly attacked by rust; the crop lodged throughout the plot.
$\frac{1}{12}$	XII	Found in Ranjish of Palampur ...	7th November 1910.	27th February 1911.	24th April 1911	13	31	61	8	18	0	23	2	...	$\frac{1}{12}$ (4½′)	...	Germination regular; tillering good; slight affect of rust. The crop lodged throughout the plot.
$\frac{1}{32}$	IX	Lal Kale Kasarwali (standard) ...	7th November 1910.	3rd March 1911	23rd April 1911	23	1	66	16	...	...	...	...	...	$\frac{1}{12}$ (4′)	...	Germination regular; tillering fair; rust bad; very little lodging.
$\frac{1}{12}$	XIII	Found in Lal Kale Kasarwali of Lyallpur; hard red of Gujar Khan.	7th November 1910.	6th March 1911	24th April 1911	16	34	56	34	19	0	21	3	...	$\frac{1}{12}$ (4¼′)	...	Germination regular; tillering good; slightly more rusted than type No. 12.
$\frac{1}{12}$	XIV	Found in Lal of Karnal, Sialkot, Attock; Lal Sufed of Sirsa; Lal of Zira; Lal of Ludhiana; Kasalu or Surkh of Ferozepore; Ratti or Lal of Pind Dadan Khan; Desi Surkh of Jullundur; Lal Desi of Jhelum; Lal of Delhi and Rawalpindi; and Kunjhari of Muzaffargarh.	7th November 1910.	25th February 1911.	22nd April 1911	15	15	49	38	18	28	28	8	$\frac{11}{180}$ (4′)	$\frac{1}{45}$ (3½′)	...	Germination regular; tillering fair; very slightly attacked by rust; very little lodging.
$\frac{1}{12}$	XV	Found in Ratti or Lal of Pind Dadan Khan; Watni of Shahpur; and Kunjhari of Multan.	7th November 1910.	27th February 1911.	20th April 1911	19	1	54	6	24	0	25	30	$\frac{11}{180}$ (4½′)	$\frac{1}{45}$ (4¼′)	...	Germination regular; tillering fair; rusted rather more than type No. 14; very little lodging.
$\frac{1}{12}$	XVI	Found in Ghoni of Lahore; Sufed of Ludhiana, Rohtak and Batala, Daudkhani of Dasuya and Delhi; Rori of Montgomery; Sufed Kasarwali of Lyallpur.	7th November 1910.	27th February 1911.	21st April 1911	16	34	42	18	24	0	26	34	$\frac{11}{180}$ (3¾′)	$\frac{1}{45}$ 3½′)	...	Germination regular; tillering fair; slightly attacked by rust; very little lodging.

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REPORT ON THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, PUNJAB, FOR 1911-12.

1911/12

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No. 649.

FINANCIAL COMMISSIONERS' OFFICE:
Dated Lahore, 7th October 1912.

FROM

A. M. STOW, ESQUIRE, I.C.S.,
Senior Secretary to the Financial Commissioners, Punjab,

TO

THE HON'BLE MR. H. P. TOLLINTON, I.C.S.,
Revenue Secretary to Government, Punjab.

The Hon'ble Mr. A. H. Diack, C.V.O.

SIR,

I AM directed to submit the Annual Report on the Operations of the Department of Agriculture, Punjab, for the year ending 30th June 1912, together with a separate note containing the comments of the Financial Commissioner.

I have, etc.,
A. M. STOW,
Senior Secretary to the Financial Commissioners, Punjab.

Note, dated 3rd October 1912, by the Hon'ble Mr. A. H. Diack, C.V.O., First Financial Commissioner, Punjab, on the Annual Report of the Department of Agriculture, Punjab, for the year ending 30th June 1912.

Paragraph 2 of report.

The first batch of students have now completed their three years course. The Financial Commissioner notices with regret the verdict of the Examiners that there is too much cram, and too little power of practical application. He is unable to endorse Mr. Hamilton's view that the aim of the College is to produce scientific not practical farmers. In a province where every male in the rural population is a practical farmer it is difficult to say what success can be achieved in after life by a student who is unable to apply practically the education he has received at the Lyallpur College. The Financial Commissioner is glad to observe that the District Officers have shown greater co-operation in the important matter of selecting nominees for scholarships, and is enquiring why suitable candidates are said to be wanting in the Lahore division.

Paragraph 4 of report.

Pages (*viii*) and (*ix*), Appendix III to report.

Paragraph 7 of report.

Paragraphs 5 and 9 of report.

Paragraph 6 of report.

Paragraph 13 of report.

2. Research and experiment now cover a wide field, and the Financial Commissioner considers that much useful work has been done at the Lyallpur and Gurdaspur Stations. The principal investigations concern the most valuable crops,—wheat, cotton and sugarcane. The survey of the various wheats in the province continues. The results of the milling and baking tests are interesting, and the attempt to ascertain the home market value of selected red wheat should not, Mr. Diack thinks, be abandoned. The reports on American cotton, quoted by Mr. Milne, are encouraging, and there can be no doubt that with a favourable season good results should be attained. The completion of Mr. Barnes' analysis of the Gurdaspur sugarcane will be looked for with interest. The Financial Commissioner is inclined to doubt whether the problem of safeguarding cotton from bollworm and sugarcane from moth borer has been tackled with sufficient energy. No question is of more importance than the protection of these valuable crops from insect pests, and Mr. Diack trusts that it will not be long before more definite results are arrived at. The unusual demand for Indian barley in Europe has stimulated interest in this crop which, though not widely grown, is of prime importance in certain tracts of the south-eastern districts. The progress in the improved cultivation of date-palms described by Mr. Milne is most satisfactory.

Pages (*xv*) and (*xvi*), Appendix VI.

3. The Deputy Director is to be congratulated on his conduct of demonstration work at Lyallpur, Gurdaspur and out-stations. In view of the common but erroneous opinion that the improvements in agricultural implements and farming, which the Agricultural Expert attempts to introduce, are beyond the means of the ordinary zamindar, it is satisfactory to notice that the Department is now in a position to recommend cheap ploughs suitable both for light and heavy work. The improved "Meston" plough, for instance, which has given general satisfaction costs only about Rs. 6, and is of lighter draught than the *desi* plough. This plough it is interesting to observe is being stocked for sale by Co-operative Societies in Jullundur and Hoshiarpur. The demand for chain harrows on loan from the Gurdaspur Station has been so great that the zamindars were ready to pay Re. 1 per day for their use.

Paragraph 14 of report.

The Director has introduced in 11 districts his scheme for bringing District Officers and the cultivator into close relations with the work of the Department by means of agricultural associations. But no allusion is made

Page 17.

in his report to the existence of over 650 rural Co-operative Societies at no great distance from the Gurdaspur Station possessed of capital and enterprise sufficient to stock improved implements for sale to their members or to purchase threshing and reaping machines to be let out on hire. It is satisfactory, however, to note from the Deputy Director's report that with an increased staff of agricultural assistants organised demonstrations are now to be conducted in villages where co-operative societies exist. While admitting the value of agricultural associations presided over by Deputy Commissioners, the Financial Commissioner cannot but think that the future both of the Agricultural Department and of the co-operative movement lies in their mutual interdependence. This is a principle which formed the subject of a resolution at the last Pusa Conference, and is fully recognised in the working of the Co-operative Societies in the United Provinces.

Paragraph 7 of report.

Paragraph 15 of report.

Paragraphs 10, 11 and 12 of report.

4. The result of the experiments in the reclamation of *kállar* soils which will probably be carried out in the ensuing cold weather will be watched with interest. The progress in well-boring is reported to be satisfactory, but it is clear from the Director's report that more co-operation is required on the part of the revenue staff in districts where well-boring operations are being undertaken. Improvements in sericulture, pisciculture and poultry farming have hardly advanced beyond the experimental stage, but good work has been done and the results are by no means discouraging.

5. The record of the year, the Financial Commissioner thinks, reflects credit on the Director and the agricultural experts. The transfer of the Deputy Director, Mr. Milligan, is a real loss to the Province. Associated with the work of the Provincial Agricultural Department from its commencement he acquired the confidence of the people, and has inaugurated the practical application of science to the agriculture of the Punjab.

Punjab Government Press, Lahore—7-10-12—215—450—P. B. S.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH *JUNE* 1912.

Administration.

1. Mr. Hamilton was Director throughout the year. The staff suffered a great loss by the transfer of Mr. Milligan, Deputy Director, to Pusa as Imperial Agriculturist. His kindness and great practical skill in agriculture had won the full confidence of the zamindars with whom he came in contact. He was succeeded by Mr. Southern, who joined the appointment on May 18th, 1912. Lala Madan Mohan Lal, on completion of his training at Pusa, joined as Assistant Professor of Entomology on 16th October 1911. The post of Assistant Professor of Mycology was abolished during the year, and the incumbent, Mr. J. H. Mitter, reverted to his substantive appointment at Pusa. Three new Agricultural Assistants, four Chemical Research Assistants and one Demonstrator were appointed during the year. A temporary appointment of Lecturer in Physics and Mathematics was sanctioned for one year from September 6th, 1911. The superior staff is still below the sanctioned scale, and progress outside Lyallpur and Gurdaspur is seriously hampered by the want of a second Deputy Director and of an Agricultural Engineer.

The College.

2. Appendix I gives the history of the College. The conclusion of the three-years course of the first batch of students at the Lyallpur College furnishes an opportunity to take stock of the education purveyed there. The verdict of the examiners is that there is too much cram and too little power of practical application. I gather that the Lyallpur students are no worse in these respects than the students of any other Indian Agricultural College, nor indeed than the students of any other Indian College in which the education has a practical side. It is necessary, however, to see how the dangers of cram can be reduced and how the curriculum of the College can be altered so that the students may never be allowed to forget the practical use of the sciences taught them. This will be done during the coming year. At the same time it must be remembered that the College is an educational institution not a training College for an occupation or a profession, and the scientific, not the practical farmer, is what we should aim at turning out. The professional training cannot be completed at College any more than the man with a first class in the Law School can be recommended as an efficient cross examiner in a criminal case. The large increase in the number of nominations for scholarships and the greater co-operation of district officers is satisfactory. It is extraordinary, however, that Lahore, the richest division in the province, cannot provide any suitable candidates. A short vernacular course will be started in October 1912. The conditions and curriculum are under consideration. The Financial Commissioners have sanctioned the preparation of schemes for the improved farming of the larger estates under the court of wards, and schemes are now being drawn up in communication with Commissioners. Students who have obtained the diploma will be available for employment as agricultural experts in these estates.

Research and experiment : general agriculture.

3. The Professor of Agriculture draws attention to the following results obtained on the Lyallpur farm during the year under report ;—

(1) Nitrates either in the form of $Ca (NO_3)^2$ 2 or nitre have very little residual effect in the succeeding season.

(2) $Ca (NO_3)$, although giving a distinct increase of yield when applied to wheat, is still not paying at the present price of the manure, which is Rs. 9 per maund.

(3) The different spacing of cotton has not shewn the results expected but the season was unfavourable for cotton in the Lyallpur district and the results of the experiment are probably unreliable.

(4) Intertillage and sowing of cotton in lines has proved beneficial,

(5) Green manuring, although the season was unfavourable, has given encouraging results.

(6) In the manurial series lime and gypsum seem to exercise a better effect on the soil than could be expected from the value of these manures as plant food.

On the Gurdaspur farm the results obtained by harrowing the young chari and wheat crops are noteworthy. In the case of both crops the yield on the farm was considerably better than that of crops grown in the neighbourhood, and this result was chiefly due to the use of the harrow.

Research and experiment : Wheat.

4. Our policy with regard to wheat-growing was indicated in last year's report. In furtherance of it those wheats which appear to be the best yielders have been grown on extended areas in the past year. These were types Nos. 9 and 11, in Lyallpur, and types 13 and 14, in Gurdaspur. Type No. 9 has yielded well on the farm, but very poorly when grown by zamindars outside, the average yield being only 11½ maunds on 204 acres. In 1910-11 it was not successful as a yielder on the farm. So far as has been ascertained this wheat grows nowhere in the province, it needs good land and good cultivation, and the grain is dark and ugly. Apparently it must be given up notwithstanding its good straw and its high nitrogen content; and once again the wisdom of the zemindars has to be recognized. Arrangements, however, have been made to retain a certain quantity of seed for distribution to anyone who applies for it, but it will be recommended only for really good land. Type No. 11 yielded well on the farm and also has averaged 20 maunds an acre when grown on 16 acres by zamindars. This wheat is really nothing more than the ordinary Lyallpur *lal kasarwali* freed of admixtures. It is commonly grown in Lyallpur and parts of the Ferozepore district, and 500 maunds of seed are being stored for distribution in the former district, but no staff is available for distribution work in the Ferozepore district. Types Nos. 13 and 14 have both done extremely well in Gurdaspur, and have responded to good cultivation. They are the common wheats in Gurdaspur, Jullundur and Hoshiarpur. As, however, nearly the whole crops was steam-threshed this year only 29 maunds of No 13 and 58 maunds of No. 14 are available for distribution. This seed will be sown on the demonstration areas referred to in paragraph 14.

Pusa wheats : Pusa, 8, 12 and 22 and 9 E 1, 9 E 3, 9 E 9, 9 E 10, 9 E 13, 9 A 7.

Nine wheats sent from Pusa, of which six are crosses of Mr. Howard's, were grown at Lyallpur and Gurdaspur. At Lyallpur, all yielded fairly well, 9 E. 1 and 106 doing best, but they shewed no superiority over Punjab wheats, and all rusted slightly. At Gurdaspur, Pusa 12 grown unmanured and unirrigated yielded nearly 26 maunds an acre, but all the others were disappointing and badly rusted. Apart from rusting and yielding poorly the crosses shewed no special characteristics of their own. In accordance with the proposals sanctioned in Punjab Government letter No. 181 of 15th October 1910, 150 maunds of red Gujar Khan wheat (nitrogen 1·54) and 150 maunds of red Moga wheat (nitrogen 1·7[illegible]) bought in the mandis by Messrs. Ralli Brothers and the Deputy Director were sent to four millers in Scotland with whom arrangements for milling and baking tests were made by Sir James Wilson, K. C. S. I. The reports received are astonishingly divergent. Both wheats appear to be of similar quality. One firm found the wheat very badly infected with weevils and said there was no chance of further business; another said the yield of flour was very unsatisfactory, varying from 63 per cent. to 65 per cent., but otherwise both wheats make good flour, considerably superior to ordinary red Karachi, and apart from the small percentage of flour were quite desirable from a miller's point of view; a third said that the wheat was very free from weevil, the flour percentage was very high (73 per cent.), and they would be glad to purchase more for mixing in scone flour ; but their bakers regarded the flour as unsuitable for Scotland, owing to the quality of the gluten being very poor, and likely to be more suitable for England where the quick-firing system of baking is in vogue. The fourth miller reported that the quantity sent was too small to permit of a reliable test and so it was disposed of to other millers. *Quot homines, tot sententiae* and the more reason to choose for distribution only wheats which will yield heaviest in each locality under diverse climatic conditions.

This year it was proposed to send home 3,000 maunds of No. 9 wheat to see what a fairly large consignment of strong red wheat would fetch on the market in comparison with choice white Karachi ; but the outturn of No. 9 was so poor, that the intention of distributing it had to be abandoned, and so the home market value no longer remained a matter of interest.

Surveys have been made of the wheat in the Jullundur and Ferozepore districts and in the tahsils of Pindigheb, Tallagang and Chakwal of the Attock district. The results have been as follows :—

Pindigheb, Tallagang and Chakwal.—The types sown are almost exclusively Nos. 14 and 15, nearly pure.

Jullundur.—(1) Nos. 14 and then 13 are the predominant wheats both in irrigated and unirrigated lands.

(2) Nos 16 and 10 are the most popular white wheats, and are usually grown in the better lands and with irrigation.

Ferozepore.—In the Ferozepore and Zira tahsils red wheat is preferred, and type No. 14 is that most commonly found, while types Nos. 18 and 10 are the commonest white wheats.

In the other three tahsils, where there is more canal irrigation, white wheat of types Nos. 10, 12 and 11 are most grown, while there is also much red wheat of type No. 14.

A tour by Mr. Hamilton in the Montgomery district shewed that the results given for the Dipalpur and Pakpattan tahsils last year are not quite correct A re-survey will be made. The types A and B, large club-headed beardless white wheats, one with hairy and the other with hairless flumes, seem to be the commonest wheats on the inundation canals. It is strange that two widely grown and probably heavy yielding wheats with these marked characteristics escaped notice when the Imperial Economic Botanist sorted out the Punjab types.

Research and experiment: Cotton.

5. Not much progress has been made in cotton. The fact is that up to date there has been far too little co-ordination between the various experts to allow of anything like a consistent policy to be persevered in. A brief statement of policy has been drawn up, approved by Government and printed. In the case of American cotton—the only exotic which is likely to succeed in the Punjab—it is important that the varieties selected should be early ripening, as canal water becomes scarce in September and October. One variety hitherto sown on the farm (3 F = 199 F. Bot. ser) and two varieties (168 F. and 179 F. Bot. ser.) which the Economic Botanist has handed over to the farm for multiplication appear to present this and other desirable qualities. Samples of the lint of the 26 specimens of American cotton were submitted to various persons and associations interested in cotton-growing. The replies received are given and fully discussed in appendix III. The cotton of which the lint is longest and finest (161 F) is unfortunately a late type and the proportion of lint is not high. However, there is good hope that one of these American cottons will be found more suitable for the Punjab and truer to type than the acclimatized American seed now imported annually from Dharwar.

As to the still more important work of the selection and comparison of the different botanical types of cotton comprised in the mixtures commonly called Hansi cotton and Multan cotton, little has so far been done. The various types will now be grown separately not in Lyallpur alone, but also out in the districts and yield, length and percentage of lint compared.

One great step forward during the year has been the definite demand in the Lyallpur market for American cotton which has been bought by the mills at Re. 1 or more a maund above country cotton and separately ginned.

The erection of a large new spinning mill at Bhiwani appeared to provide an excellent opportunity for introducing longer stapled cotton in that neighbourhood, and some American cotton has been sown there ; but a lot of troublesome accidents, including the stoppage of goods booking on the Rajputana-Malwa Railway, have limited the scope of the trial sowings.

The ravages of the bollworm are discussed in the following paragraph American cotton in the Lyallpur district suffered much less than country cotton because the outbreak of the disease occurred during the flowering season, and the flowering period of American cotton is longer. Even with these points in its favour the demand for American seed has been disappointingly small, and only 83 maunds have been sown this year.

Bollworm (*Barias insulana*) appeared in the cotton of the Delhi division, of the Lyallpur district and of the Jhelum Colony in great numbers and in other districts less formidably in the end of July and beginning of August. The Imperial Entomologist came to the Punjab to assist us and also lent us an assistant, and members of the department visited many tracts to ascertain the extent of the damage being done. Bollworm parasites were obtainable nowhere in India. Accordingly at first the only thing to be done was to advise the cultivators to pick off and burn or bury all infected bolls and buds. This was advertised very widely, but, owing of course to the immobility of the Indian peasant from the rut of custom, it is doubtful if the picking done was really very extensive. But in many tracts the people were thoroughly alarmed by the threatened total destruction of their crop and so yielded to their fears rather than to our reasons. We also sent out parasite boxes, and asked the Deputy Commissioners to fill them with bollworm-affected cotton in the hope that the parasites might appear in the boxes and escape into the fields and breed. This was probably a useless measure, and it is doubtful if it is worth while sending out parasite boxes except when there are parasites to send out also. What saved the situation in the Punjab last year was undoubtedly the heavy winds and rain which visited the province in the last few days of August. These apparently swept and washed the plants clean of infected bolls, eggs, and pupæ and drowned them upon the ground. We did not find parasites till September 6th, although consignments of infected bolls were being sent in regularly from many districts to Lyallpur for examination. Where bollworm was prevalent the first two pickings were entirely lost, with the result that the first cotton came to the mills very late. The cotton plants flowered and fruited most abundantly in the end of the season to make up for lost time, but frost prevented ripening in some districts. Under the advice of the Imperial Entomologist we kept a plot of cotton, infected with bollworms, throughout the cold weather and put down hollyhocks through the cotton to ensure sufficient food for the worms. Man's proposal is that as the bollworms multiply and overtake the food supply, nature will restore equilibrium by the appearance of the parasites, but providence had not up to June so disposed and *Rhogas Lefroyi* was provokingly absent. Parasites were then imported from Pusa.

At the time of writing, bollworm thanks to the good rainfall, has appeared nowhere in the province except in the Lyallpur and Shahpur districts. Fortunately the parasite has appeared also in considerable numbers and a bad attack is not anticipated. The general effect on the cotton crop of the outbreak in 1911 is discussed in the Season and Crop Report.

Research and experiment: Barley.

6. Owing chiefly to the failure of the Russian crop, there was a greatly increased European demand for Indian barley in 1911-12. The exports from Karachi in that year amounted to 221,026 tons as compared with 11,112 tons in 1910-11, while the price of barley nearly equalled that of wheat. English maltsters report that the quality of the consignments was very unequal, some being excellent and very suitable for malting, while others contained so much of dead grain and foreign substances as to be useless. If more care is taken to

export only sound grain, it is probable that Indian barley will continue to find a European market. Appendix III shews the results of experiments already conducted with varieties of barley at Lyallpur, and it has been arranged that the Economic Botanist and the Deputy Director of Agriculture shall tour in the chief barley-producing tracts of the province—Ferozepore, Hissar and Gurgaon—next harvest time, and get into touch with buyers and growers. An agricultural assistant will also be deputed to make a rough survey of these districts and to collect types. These and the most successful varieties grown at Lyallpur will then be analysed and tested to ascertain their malting and agricultural qualities.

Research and experiment: Chemistry.

7. Details of the year's work are given in appendix V. The result of the analysis of Gurdaspur cane has been printed for the information of Government, the Financial Commissioners and the officers of the Agricultural Department. As the investigation is incomplete, no definite results can be stated, and Mr. Barnes has given good reasons for considering that the crop of 1911 in Gurdaspur was above average, but even so it looks as if the quality of the cane would not present any obstacle to the establishment of a central sugar factory in the best cane-growing locality. As regards the difficulty mentioned by the agricultural chemist of estimating the yield of cane, it would be dangerous to rely too implicitly on the yields obtained at the Gurdaspur Farm, as the factory if established will be fed by cane grown by zamindars and not by agricultural experts with unlimited resources. The yields of irrigated cane assumed by the Settlement Officer for the Eastern Nahri and Bangar circles of the Batala tahsil, in one or other of which the central factory would probably be located, are 29 and 27 maunds per acre, respectively.

Since the close of the year sanction has been given to the experiment for reclaiming kallar soil, which Mr. Barnes has proposed after five years' investigation into alkaline soils. Three squares of the worst affected land will be taken up in the Lyallpur colony. A number of mole drains, 200 yards long, will be ploughed across it at intervals of 8 yards, opening into a central drain. The land will then be flooded heavily enough to wash out the salts, and the alkaline water will be carried off into a shallow tank at the end of the open drain. It is hoped to start the experiment next cold weather, if the necessary plant arrives from England in time.

Research and experiment: Botany.

8. Details of the year's work are given in appendix III. The points requiring attention have been already noticed.

Research and experiment: Entomology.

9. The measures taken to combat the ravages of the bollworm have been described in paragraph 5. The damage done to sugarcane by the moth borer is serious, and experiments were started at Lyallpur during the year to ascertain the best method of dealing with this pest. Maize and jowar have been sown as trap crops, and the expediency of cutting the dead hearts of the young cane has also been tried. These methods appear likely to give good results, but the experiments are not yet complete.

Sericulture.

10. Two experiments were conducted at Lyallpur. Half an ounce of Mysore seed was imported to test its value for autumn rearings in the Punjab. The experiment failed because the rearing was started about a fortnight too late. The unusually severe cold of last November killed off most of the worms, and those which survived spun only small cocoons containing very little silk. The second experiment was conducted in the spring. It was undertaken at the request of Messrs. Anderson, Wright & Co., of Calcutta, and its object was to breed moths and get second-generation European seed ascertained by microscopical examination to be free from disease. By proper "grainage" we succeeded in producing the required seed, and it was sent to Calcutta for cold storage in April. Experimental rearing from Italian cellular seed was also attempted with fair results, 16 seers of dry cocoons being obtained from 1 oz. of the seed.

As regards outside work, silk worms were reared generally by the same persons and in the same places as last year. One hundred and ten ounces of seed were distributed, and some of the results are tabulated below :—

			Cocoons	
	Issued.	*Hatched.*	*Green*	*Dry.*
Salvation Army ...	25 ozs.	25 ozs.	550-600 seers	...
Nahan State	3¼ ozs.	3¼ ozs.	...	38 seers
Canal officers	7⅔ ozs.	7¼ ozs.	331 seers	108½ seers.

A tour taken by Mr. Hamilton in the Gurdaspur district shewed that no progress has been made in the methods of rearing. The worms are spread on leaves on the ground usually with not even matting under them: they are overcrowded and underfed. Each rearer has far more seed than he can find accommodation for. Much country seed is imported, especially to Narot, from the Kangra district at a very low price. This country seed is hatched out in enormous quantities, but the death rate of the worms is very high. Measures will be taken to stop the rearing of this seed and the consequent risk of disease. The demonstrations undertaken by canal officers seem to have served their purpose and need not be continued. It is hoped next year to extend rearings to Kangra and Sialkot and to places near canal mulberry plantations, where the people are not so confined in the ruts of hereditary insanitary practices. Preparations are being made for beating up rearers early in the cold weather and for rendering them systematic assistance during the rearing season.

Pisciculture.

11. Mr. Howell, who has contributed the material of this paragraph, was on special duty during the year in connection with pisciculture. After studying the methods employed in America and Madras he returned to the Punjab in December.

(a) Conservation of indigenous species.

The directions in which it is proposed to take action are three-fold. First the provision of adequate ladders at all weirs on the main rivers, which obstruct the free movement of migratory species; secondly, the protection of the spawning grounds, and, thirdly, the prevention of the wholesale destruction of fry and immature fish in the canals during closure. A disused supply channel of the Lower Chenab Canal at Chenawan is being adapted as a breeding and stock pond for the more valuable cyprinoid species like *rohu*, *catla* and *mori*. An outlet for running the canal dry when required is being constructed. The more predacious species have been removed, and in the autumn the channel, which has been proved to abound with fish food, will be stocked with fry.

There are probably few countries in the world which can compare with the Punjab with its thousands of miles of harnessed rivers as a field for rough and ready methods of pisciculture, and the indigenous species are mostly so hardy and so prolific that with reasonable protection through the egg and larval stages they cannot fail to increase and multiply.

(b) Trout culture.

Brown trout have been introduced into the Beas in Kulu, certain tributaries of the Beas in Kangra, into the Giri and various other hill streams. It is probable that for the next few years the results will be considered disappointing, as trout never multiply at the miraculous rate which enthusiastic anglers expect. However, the species thrives well in Kulu and Kangra, and makes very rapid growth, as yearlings of ¾lb. weight and four year old fish of four pounds and over have been caught. The Kulu stock ponds have been enlarged and improved. The stock fish are in splendid condition and average about four pounds in weight. They were hatched out in April 1909. They spawned last winter, but mistakes were evidently made in handling the spawners, and only a couple of hundred eggs proved fertile. With the properly constructed hatching troughs, which are being made, and with the aid of a trained hand from Kashmir, it is hoped to do better next winter. The 120 fry which represent the meagre, but not discouraging results of 1911-12, are doing well.

Poultry.

12. Poultry, especially the exotic varieties, suffered severely from the heat of May and June, but did better than in previous years. A poultry committee has been formed by the Assistant Adviser to the Government of India ot which the Professor of Agriculture, who is in charge of the poultry experiment at Lyallpur, is a member. As a result of the exchange of views on the committee, it is proposed to keep fewer varieties and to try to do more with the best indigenous breeds of the province, of which there are some promising specimens at Lyallpur.

Date palms.

13. Full details of the progress made in the conduct of this experiment are given in appendix III. The fruiting of the trees planted in 1910 is most satisfactory. A further supply of 2,000 suckers has been ordered from Arabia, and is expected to reach India shortly. All the fruit, which the Punjab can produce, is for many years likely to be consumed in the province, but it is proposed to send a few boxes of the very best Punjab dates to the London market to test their value.

Demonstrations.

14. Owing to want of staff demonstration work was restricted during the year At Lyallpur classes for instruction in the use of the reaper were held in April The remaining work was conducted by the Deputy Director of Agriculture and is described in Appendix VI. Now that more agricultural assistants have been appointed, more outside demonstration work can be undertaken At the close of the year under report steps were taken towards renting a plot of typical barani wheat-growing land in the Attock district with a view to demonstrating on the spot the improved methods of cultivating barani wheat, which gave such striking results on the Gurdaspur farm last season (paragraph 4). Unfortunately the Deputy Commissioner has not so far succeeded in procuring suitable land for the department, and the work of demonstration will be delayed. This farm will be in charge of an agricultural assistant, who, in addition to supervising work on the farm, will be available for conducting demonstrations in neighbouring tracts. At the same time the scheme outlined in paragraph 12 of last year's report was launched, and the Deputy Commissioners of 11 selected districts were addressed with a view to the formation of agricultural associations on the lines which are reported to have been so successful in the Central Provinces. Details of the scheme are given in Mr. Hamilton's letter No. 1788—1-11, dated May 4th, 1912, and the results will be described next year.

A large number of applications for seed were received and complied with as far as possible. Forty-five maunds of Hansi and farm selected cotton seed, 83 maunds of American cotton seed, and 227 maunds of wheat, chiefly of types Nos. 9 and 11, were sold.

Agricultural engineering.

15. The progress made in the production and distribution of labour saving machinery and in well boring is described in Appendix VI. One of the main functions of the agricultural associations mentioned in the preceding paragraph will be to familiarize the Punjab cultivator with the use and advantages of the improved types of tillage implements. The farm tenants at Lyallpur continued the use of the Raja plough and spring-toothed harrow with increasingly beneficial results, the yield of wheat on 66 acres of tenant cultivation averaging 16½ maunds per acre as compared with 12 maunds 13 seers last year.

On the whole the progress made with well boring has been satisfactory, and if one or two sets of deep boring and rock cutting plant are purchased, the coming year should show still better results. The most unsatisfactory feature of the year's work is the large number of days during which the borers remained idle for want of work or for want of labour. Out of a total number of 5,055 days only 1,230 were spent in boring while 1,225 days were wasted for want of work and 873 days for want of labour.

The apathy of Tahsildars is said to be the chief cause of this loss of Government money. We do not want them to select wells for the borers, but we do want them, when on tour, to explain to the people the advantages of well boring and to take an intelligent interest in the results. With regard to want of labour it is reported that in some cases where men are willing, but unable to provide it locally, and apply for assistance to the tahsil, their applications are totally ignored. The possibilities of tube wells and of the substitution of oil engines for bullock power are being borne in mind, and a tube well has been ordered for the irrigation of the Gurdaspur farm. But it is again necessary, at the risk of wearisome repetition, to point out that the efficient management of well boring operations and the development of irrigation by tube wells and oil engines can never be properly carried out until a properly qualified agricultural engineer is appointed.

Publications and supply of information.

16. The following publications were revised and reprinted during the year:—

(1) Bulletin No. 3 of 1910, (reissue of 1912) (Notes on silk worm rearing in the Punjab).

(2) Brief instructions (in Vernacular) for rearers of silk worms.

Vernacular leaflets on the following subjects:—(1) Reaping machine, (2) winnowing machine, (3) the use of the chain harrow, (4) green manuring, (5) furrow turning plough, (6) eradication of dab grass, (7) cultivation of American cotton, (8) cotton cultivation, and (9) maize cultivation were prepared and printed and will be issued to cultivators at the local demonstrations referred to in paragraph 14.

General.

17. Mr. Hamilton proceeded on privilege leave on July 4th, and the writing of this report has devolved on me. Most of paragraphs 2, 4, 5, and 9 were drafted by Mr. Hamilton before he made over charge. The year has been one of steady progress, and the expert staff are to be congratulated on the energy, skill and sound judgment with which the work of the department has been carried on.

B. T. GIBSON,

Officiating Director of Agriculture and Industries, Punjab.

13*th September* 1912.

APPENDIX I.

ANNUAL REPORT OF THE PRINCIPAL, PUNJAB AGRICULTURAL COLLEGE, LYALLPUR, FOR THE YEAR ENDING JUNE 1912.

Introductory.

MR. BARNES being on leave, the writing of his Annual Report has devolved on me.

The Session.

The 3rd active Session of the College commenced on July 20th, 1911, with a 3rd year class of 10 students, a 2nd year class of 16 students and a 1st year class of 30 students. Seven students withdrew from the 1st year course during the session.

Courses of study.

Three courses of instruction, *viz.*, the subjects of the 1st, 2nd and 3rd year's Diploma course for the Licentiate of Agriculture have been given during the year. These consisted of lectures and practical work in Agriculture, Chemistry, Physics, Botany, Mathematics, Entomology, Land Surveying, Land Revenue, Agricultural Engineering and Veterinary Science. Mr. Hutchinson, Imperial Bacteriologist, was kind enough to give a few lectures in Bacteriology during a visit to Lyallpur in the spring. The 3rd year students spent a fortnight at the Military Dairy, Ambala, permission to attend having been kindly granted by Assistant Director of Farms, Army Head-Quarters, Simla. They spent a very useful fortnight under the care of Mr. Dunwoodie, the Superintendent.

Diploma Examination of the Punjab Agricultural College.

The first Diploma Examination was held in April 1912, lasting from the 15th to the 30th April. The following assisted as external examiners :—

Mr. Milligan, Deputy Director of Agriculture	Agriculture and Mathematics.
Mr. Clarke, Agricultural Chemist, United Provinces	Chemistry.
Professor Gammie, Imperial Cotton Specialist	Botany.
Major Walker, Chief Superintendent, Civil Veterinary Department ...	Veterinary Science.
Mr. Howlett, 2nd Imperial Entomologist	Entomology.
Kh. Rahim Bakhsh, Personal Assistant to Director of Land Records, Punjab ...	Land Surveying and Land Revenue.
Mr. Gibbs, Executive Engineer, Experimental Division, Irrigation Department	Agricultural Engineering.

Ten students appeared in the examination, of whom eight were successful. At a meeting of the Examiners at the end of the examination, certain resolutions were put forward chiefly recommending the modifying of the syllabus with a view to eliminating certain subsidiary subjects early in the course so as to lessen cramming and excessive attention to theory at the expense of practical work, which the present system of examining all subjects at the end of three years tends to foster.

The Examiners also recommended that Diplomates be given further training in Farm work and management before being entrusted with posts as Estate Managers. It may here be noted that ability to fill such posts successfully rests on experience based on a sound education in Agricultural Science. The Examiners considered that the standard of education attained was high. Out of the eight successful Diplomates one has been appointed to the Chemical Section of the College on Rs. 70—7—140 and three as Agricultural Assistants on Rs. 40—6—100 in the Agricultural Department.

Sessional examinations.

Thirty-eight students were examined. The results for the 2nd year class have been very satisfactory. All passed except three, who qualified for re-examination in one or two subjects. In the 1st year class the mortality was high. On re-examination it is expected 60 per cent. will pass into the 2nd year class. As in previous years great difficulty is felt with the 1st year class owing to their knowledge of English being so defective.

Practical agriculture.

Many improvements have been made in the teaching of this subject and the progress and interest shown is very satisfactory. It is hoped to be able to take the 3rd year students for a short tour in the Province this session in order to study at first hand agricultural conditions outside the Lyallpur Colony.

Science subjects.

Progress in Science subjects is again satisfactory. A separate Assistant was appointed for Physics and Mathematics for the past session, thus freeing the Chemical and the Agricultural section from the burden of these subjects.

Agricultural Engineering.

This course was kindly given this year by A. S. Gibbs, Esquire, Executive Engineer, Irrigation Department, who took great interest in the work and gave a very valuable course of lectures and practical instruction. It is impossible to emphasise too much the importance of this subject in connection with Punjab Agriculture. The experience of the Agricultural Department during the past six years has shown that there is a wide field of improvement open in the mechanical side of agriculture in the Province. Improved methods of cultivation offer the first and most easily attained improvement in crop outturns, while Mechanical Reaping and Threshing Machinery are becoming economically possible on account of the steady upward trend of labour prices. The practical and technical value of this course for Agricultural students in this Province is obvious and its educational value ranks no less. The backwardness of India in Mechanics renders it imperative for us to give prominence to the subjects of Agricultural Engineering in an Agricultural College course, which is to play an important part in the improvement of Indian Agriculture. None of the existing staff of the College are qualified to teach this subject. In order to give Agricultural Engineering the attention which it deserves and demands we shall require the services of a specialist and a fully equipped section. Partial provision has already been made by the formation of an excellently fitted experimental workshop, attached to the College.

Staff.

The post of Assistant Professor of Mycology was abolished during the year and the incumbent, Mr. J. H. Mitter, reverted to his substantive appointment at Pusa in November 1911. Sanction was also received to the appointment of a Lecturer in Physics and Mathematics for one year only.

The College buildings.

The College buildings are complete. Sanction has been obtained for an improved water-supply embracing the College, Lyallpur Agricultural Station and the proposed dairy.

The extension of the boarding-house sanctioned for the present year was finished in August 1911 and thus no inconvenience was felt in providing accommodation for students.

Hostel.

The boarding-house has remained under the Superintendentship of Mr. Ram Gopal Assistant Professor of Botany, who carried on the work to the satisfaction of the Prinicipal. As in previous years, every effort was made to render the leisure hours of the students pleasant and attractive, and I have pleasure in noting that many of the members of the subordinate staff co-operated heartily in this work. The College Athletic Club and the Scientific and Literary Society are in a flourshing condition.

Grounds.

The laying out of the grounds is now complete, some trouble has been experienced with the lawns and with the water supply, but these difficulties will no doubt be overcome shortly.

Workshop and electric plant.

The electric plant was working from the beginning of August 1911 and has contributed very much to the efficiency of Laboratory work, especially during the hot season. Some slight additions were made to the equipment of the Workshop and the latter is now very well equipped and able to give a large amount of assistance to all sections in the way of repairing apparatus and implements and carrying out new designs.

Entrance Scholarship Examination and applications for admission.

The Entrance scholarship examination was held on 8th May 1912 and the following days. Thirty-five nominations were received and 22 candidates appeared for the examination Of these 7 had passed the Matriculation and the remaining 15 appeared in 1912. There was scarcely any competition as far as the Lahore division is concerned. Out of the 7 nominees one appeared and was not sufficiently well qualified to be awarded a scholarship.

The awards were as follows :—

Delhi division	2
Rawalpindi division	3
Jullundur division	3
Multan division	2
Total ...	10

Last year only 6 nominations were received, and it is satisfactory to note the greater co-operation of District Officers this year.

Admission of students.

Forty-three applications for admission, apart from Scholarship candidates, were received. When those, who have been admitted, join, the 1st year class will probably consist of —

Scholarship-holders	10
Native States and other provinces	3
Ordinary	25
Total ...	38

So far, however, only 16 new students have joined.

Income.

The income paid into the Government treasury during the year was Rs. 8,289-13-7 as compared with Rs. 3,818-0-6 for the year ending 1910-11. The increase is due to the increase in the number of students and increase in the rate of fees.

Expenditure.

The contingent expenditure of the Principal's office amounts to Rs. 20,161-4-4 as compared with Rs. 20,992-6-2 in 1910-11.

The Library.—The Library suffered a serious loss owing to the transfer of about 900 bulletins and several periodicals to the Director of Agriculture's Office in Lahore in July 1911. At the end of June 1912 the Library contained 7,300 volumes : of this 300 new books were bought during the past session.

Training of Civilian officers.

This year His Honour the Lieutenant-Governor sent five newly-joined Assistant Commissioners to Lyallpur for one month's training in Agriculture under the direction of the Professor of Agriculture. This is a new departure for the Punjab and it is to be hoped will be continued in the future. Every effort was made to make the time spent as useful as possible, and I have much pleasure in reporting the interest taken by all throughout the course.

W. ROBERTS, PRINCIPAL,

Punjab Agricultural College, Lyallpur.

APPENDIX II.

ANNUAL REPORT OF THE LYALLPUR AGRICULTURAL STATION FOR 1912.—

1. The season was in many respects unfavourable. Scarcely any rain fell in July and the greater part of August except 1·5 inches towards the end of the month. This contrasts unfavourably with the previous year when as much as 9 inches of rain fell in this period. The total rainfall for the year amounted to 7·73 as compared with 19·75 in the previous year and 16·34 for the average of the previous 6 years. 1·63 inches fell in the latter part of January and this proved of great use to the wheat crop. No rain fell in February and March and wheat was very free from rust this year. Owing to the low rainfall in the kharif it was found difficult to sow san hemp, the irrigation water being required for other crops. The season was unfavourable for sugarcane and cotton. The steady drought also undoubtedly encouraged the boll-worm which attacked cotton all over the province from July to the end of August. Heavy rain and wind at that time had a most remarkable effect in checking the pest and it was noticed that a large number of affected bolls had been shaken down and the catterpillar drowned in the water,—*vide* statement I.

II.—Sugarcane, maize and cotton manurial experiments.

This experiment is to test the effect of organic and nitrogenous manures on sugarcane and the residual effects on maize and cotton.

The following diagram shows the treatment of the various plots. Green manuring with senji has been discontinued in this series owing to the difficulty in getting the land prepared in time for sugarcane after growing senji.

↑B	Castor cake	Castor cake.
	Sugarcane	
	Castor cake and calcium nitrate ...	Castor cake and calcium nitrate.
C	Farm yard manure ...	Farm yard manure.
	Cotton.	
	Farm yard manure and calcium No. 3 ...	Farm yard manure and calcium No. 3.
↑A	Nitre 4½ cwt. ...	Fallow.
	Maize.	
	Nitre 9½ cwt. ...	Fallow.

Manure is applied to sugarcane only in the rotation. In plot A half the area was fallow owing to the failure of the sugarcane in it the previous year.

It will be noticed that the plot which received extra nitre for cane yielded more than the other by nearly 5 maunds and the two manured plots yielded together 4 maunds more than the fallow areas.

The yields in the fallow areas differ by nearly 5 maunds. Both plots yielded well. The latter ripening of the fallow areas was very noticeable,—*vide* statement II.

Sugarcane.—The season was unfavourable to sugarcane and cotton. The yields are low in all cases, but the two plots with nitrates have given a total increase of 8 maunds over the plots treated with farm yard manure only,—*vide* statement III.

Cotton.—Cotton suffered from boll-worm and thus vitiated the results, but the yields are above the average of last season. Apparently there is no residual effect from the manures applied to sugarcane,—*vide* statement IV.

Manurial experiments with sugarcane, maize and cotton in kharif series, and gram, wheat and toria in rabi series.—The details can be ascertained by a glance at the table below.

Rabi ...	Gram	Toria	Wheat
Kharif ...	Cotton	Maize	Sugarcane

This experiment was designed by my predecessor with a view to study the behaviour of the soil with regard to manures and to ascertain which element or elements of plant food were most lacking. It may here be noted that chemical analysis is of very little value in showing the fertility or richness of a soil.

Maize.—The only points of interest are (1) the high yields of all plots, (2) the low yield of farm yard manure plot, this is as one would expect from the character of the season, which would naturally affect this plot more than others, (3) the high yield of the Gypsum plot. The unmanured strips were of only 12 feet width and were meant to separate the plots only,—*vide* statement V.

Sugarcane.—The yield is again comparatively low throughout. The Basic slag and lime plots seem to have held their own with other manurial plots,—*vide* statement VI

Cotton.—The variety was Hansi. Considering the season the yield is heavy throughout. The plots receiving nitrogen have proved best. The manuring of the cotton enabled it to overcome the boll-worm attack to a large extent. Affected bolls of cotton on the farm were also regularly picked off and destroyed, thus checking the pest,—*vide* statement VII.

Rabi Series.

Gram.—The yields were good throughout. Bone meal and lime yielded best,—*vide* statement VIII.

Toria.—Very high yields were obtained. The average yield as taken by the Irrigation Department for the colony is 4 or 5 maunds. There is reason to suppose that the standard is too low, but even then the present yields show the possibilities in this respect with toria. The Gypsum area is inclined to have kallar and is poor as shown in previous records when testing the area,—*vide* statement IX.

Wheat.—Yields vary from 21½ maunds with superphosphate to over 28 maunds with lime, the latter plot again giving a high yield,—*vide* statement X.

Sugarcane varieties.—As in past years the Kahu variety has given the highest yield of gur per acre,—*vide* statement XI.

Trial of Poona method of boiling versus *Punjab method.*—A rough furnace on the Bombay plan was erected and a boiling pan for same imported for this trial. The pan used in Bombay is very large compared with the Punjab pan and the furnace is somewhat differently constructed. The amount of juice in the Bombay pan is three times that in the Punjab pan. It will be noted that a saving in fuel occurs. Thus to boil twelve times in one case took 3 maunds 12 seers, in the other it took 4 maunds 28 seers. There are several points, however, still to be investigated and these will receive attention in the coming season. One of the difficulties is the time taken in crushing sufficient for a boiling with the Poona pan in a reasonable time especially with thin canes. This delay may cause deterioration of the juice. Again there is some difficulty in handling the Poona pan. It is proposed to try a modified form with another pan and to have analysis made by the Agricultural Chemist to see how much, if any, deterioration of juice takes place.

In preparing gur at the agricultural station this year the Farm Manager tried purification with suklai (*kydia calycina*) according to the Jullundur method. The gur fetched a premium of 8 to 12 annas per maund in the bazar and was of excellent colour,—*vide* statement XII.

Spacing experiment with Hansi cotton.—This experiment was conducted on acre plots, but owing to the plants in one part of the field dying off from what appeared to be root rot but was afterwards considered to be kallar, only one portion of the field comprising three kanals in each plot were weighed. The results are indefinite, but are remarkable in that apparently sowing in different distances appear to have very little effects on the yields,—*vide* statement XIII.

Different methods of sowing cotton (*Hansi and American*).—The chief object in sowing in lines is to enable greater amount of interculture to be carried out. The increase in the plots sewn in lines is undoubtedly due to this cause,—statement XIV.

Water requirements of desi *and American cotton.*—One more watering was given to American cotton as it is later in ripening than the *desi*. The much larger yield of American may be noted. The latter was much less affected by boll-worm than *desi* and the past season was much more favourable for this cotton than for *desi*,—*vide* statement XV.

Calcium nitrate experiment with wheat.—As in previous years the yield has been increased by from 3 to 5 maunds. The value of the increase, however, except in two plots, is not sufficient to pay for the manure which costs Rs. 9 a maund at Lyallpur,—*vide* statement XVI.

Residual effects of calcium nitrate applied in the previous year.—The results from a series of seven plots show that no effects may be expected from a manure like calcium nitrate in the second season. Unlike farm yard manure which benefits a number of succeeding crops, this manure is only available for the crops to which it is applied,—*vide* statement XVII.

Desi versus *Raja plough at Lyallpur Agricultural Station.*—The results are inconclusive. The area ploughed with the Raja and subsequently harrowed got into an unfavourable condition as regards tilth and had to be given a second ploughing. This, however, did not apparently make it equal to the other plots. Kallar patches were present in some of the plots,—*vide* statement XVIII.

Raja versus "*desi*" *with tenants.*—All operations were the same in this series except that two ploughings were given in one with the Raja and two in the other with the *desi*. There is no great difference in the outturn, but the increase on the whole is with the plots ploughed by the Raja. The total increase in the six plots is three maunds only. The chief immediate benefit from the inverting plough is that by inverting the soil it helps to destroy weeds, *vide*—statement XIX.

Hot weather versus *rain-ploughing for wheat.*—The results are inconclusive, the total yield on four acres ploughed in the hot weather being practically the same as on that ploughed in the rains,—*vide* statement XX.

Wheat types at Lyallpur Agricultural Station.—Types 9, 13, 11 were grown in acre areas side by side, the previous crop being cotton and senji, the other three types 12, 14, 15 were adjacent, but followed wheat as a previous crop. The differences in the yields will be noted. Type 13 has done very well this year and had been selected for special trial from results of previous years. It is a barani wheat and grown largely in Gurdaspur, Jullundur and even in Ferozepore. Types 9 and 11 seemed to be very similar in appearance, but 11 was lodged to a much greater extent than 9. As in 1910-11, however, it has given a slightly higher yield than No. 9, though the latter yielded more in 1909-10.

As regards types 9 and 11 generally, it may be noted that the average yield for No. 9 on the farm was 27 maunds 27 seers and with tenants was 18 maunds 25 seers, and of No. 11 on farm 18 maunds 4 seers and with tenants 14 maunds 14 seers. No. 9 was grown, generally speaking, in good land throughout, whereas No. 11 was often put in poor land being regarded as a better yielder than 9 under unfavourable conditions. In good land even the yielding capacity of these two wheats is similar, but the straw of No. 9 is stronger and the crop stands much better and is for this reason better suited for good land than No. 11.

It may be noted also that from experience outside the farm this year it appears No. 11 is easier to cut and thrash than No 9,—*vide* statement XXI.

With reference to other types grown, no remarks are necessary except to note, that considering a large part of the farm and tenants land is very sandy and affected with kallar, the yields are good,—*vide* statements XXI-A, XXI-B, XXI-C.

Wheats grown for the Imperial Economic Botanist, Pusa.—A number of crosses of No. 9 and some other wheats produced at Pusa were grown this year. These wheats were grown in light and in heavy soils. They have yielded fairly well but have not shown any superiority over Punjab wheats. All attacked by rust but only slightly except in a few cases noted in statement XXVI-A and XXVI-B. Type 9-E and Pusa 106 did best.

Green manuring.—Some acres of poor sandy soil were sown in square 3 with san (hemp). The crop did not do well on account of an unfavourable season and scarcity of water.

Inspite of this, however, a comparison of the yield with that of the previous year on the same area shows an average increase of 5 maunds per acre, which is very satisfactory. This year a much larger area has been sown with san (hemp) with a view to grading up some of the poorer soils,—*vide* statement XXII.

Miscellaneous experiments.

Gram versus (*gram and maize*) *as cattle food.*—In the past gram has been used as a concentrated food for the working cattle at Lyallpur. The cattle were in poor condition at the start of the test and both pairs worked regularly. The bullocks fed on gram and maize mixed, improved rapidly in condition and were doing better than the otther pair. The price of gram in the bazar was Rs. 2-6-0 a maund and of maize Rs. 2-3-0, a maund. Bhusa or crushed straw was given *ad lib* to both pairs. The experiment will be repeated in the coming cold weather,—*vide* statement XXIII.

Silo at Lyallpur.—The Director of Agriculture ordered tests to be made with siloing maize. As the orders were received late proper arrangement could not be made this year. The silo was made by digging a katcha pit in the ground 6 feet deep and 15 feet in diameter. One hundred and sixty-two maunds of chari fodder were put in on 1st November 1911, no maize being available. The pit was opened on 10th February 1912, and the silage fed to cattle from that date up to 13th March 1912. The silage was slightly bitter and was not relished by the work cattle for the first four or five days. Its feeding value, as compared to green senji (*melilotus parviflora*) was tested. A comparison with green wheat would have been better, but was not available. The price of chari at time of storing was about two annas per maund on the field. In February and March green wheat and senji sell in Lyallpur at Rs. 10 to Rs. 12 a kanal, that is Rs. 80 to Rs. 96 per acre and at annas 5 to 6 per maund retail. Should further tests with maize prove successful, therefore it seems there is a good deal of scope for siloing near Lyallpur. No safe deductions can be made from this year's test,—*vide* statement XXIV.

Cotton varieties handed over by Economic Botanist.—The two *desi* varieties have not done well last year though grown on both poor and good land.

As regards American types, 3-F and 4-F have yielded well but they are somewhat late and require an extra watering in September-October as compared with *desi* cotton.

No. 161-F though grown on good loam has not given a high yield. The staple of this cotton is very good.

No. 152-F has also a good staple and seems to be a better yielder than 161-F. These cottons are being tried side by side in several duplicate plots this year,—*vide* statement XXV.

W. ROBERTS,

Professor of Agriculture, Punjab Agricultural College, Lyallpur.

APPENDIX III.

Annual Report of the Economic Botanist, Punjab.

Prefatory.—Practically the whole of my time during the past year was taken up in preparing and delivering lectures and in preparing work for, and conducting, the practical classes in Botany. We have now got once through the 3-year course, and as I have had the work of the course put on record as the classes have proceeded and the staff have had three years' training and experience, it is to be hoped that more time may be spared for economic work in future.

The staff of the Economic Botanist is the same as it was last year and consists of three Agricultural Assistants. I wish to acknowledge the assistance of Agricultural Assistant M. Muhammad Hussan on cotton work; Agricultural Assistant Bhai Harnam Singh on wheats, and Chaudhri Ata Muhammad on work in connection with the canal weed, etc.

There have been no other material changes in the section.

Annual Report of the Botanical and Mycological Sections of the Punjab Agricultural College, Lyallpur.

Botany.—Practically the whole of my time during the year has been taken up with teaching and other duties connected with the College. As the whole of the 3-years' course has now been recorded in considerable detail on the files and the teaching staff have now had three years' training and experience in their work, it is to be hoped that more of my time may be spared to Provincial work in the coming year.

Assistant Staff.—Mr. Ram Gopal has been Assistant Professor in Botany throughout the year. Agha Yusaf Ali has been Teaching and Research Assistant. I wish again to specially acknowledge valuable assistance and loyal support from Agha Yusaf Ali both in the College and in research work.

Herbarium.—The herbarium has been added to, a little, but still requires a great deal of work to bring it up to what it should be.

Museum.—With the help of the very good collection of exhibits from the Lahore Exhibition, the Museum now contains as good a collection as one could hope for at this early stage of its history.

Teaching Collection.—This has been added to, a little, but the plants yet required to complete the scheme are extremely difficult to get and progress in procuring them will be slow.

Mycology.—Owing to want of funds the Assistant Professorship had to be abolished for the present and the section has now been included in the Botanical Section. Mr. J. H. Mitter held charge of the position of Assistant Professor of Mycology while it existed and gave me every satisfaction. I wish to acknowledge that I feel deeply indebted to him for hi[illegible]ost cordial and valuable assistance.

Students.—All the students have obtained the necessary marks in Botany for the diploma. Most of them passed very highly in the subject and three of them obtained honours in the subject. I feel very satisfied with the results of the final examinations.

Wheats.

About 10 acres of land were sown with experimental wheats this year. This land was in the area set apart for wheat and cotton experiments. It was a loam in fair condition and of fairly regular quality. The area was under cotton previously. The cotton crop was removed in January 1911. Between February and November 1911 it received the following treatment :—

Ploughing with Raja plough	1
Ploughing with *desi* plough	1
Harrowings	2
To prepare the seed bed, it received in addition —	
Irrigation	1
Ploughing with *desi* plough	1

The dates of sowing were 7th November to 23rd November 1911. The crop received three irrigations. No weeding was required. No manure was applied. The season was favourable for the crop this year. Just after the last irrigation which was given on 30th March 1912, the crop lodged, but little damage was done, as the grains had developed to a considerable extent by then. There was very little rust this year. The whole crop was slightly attacked by white ants in the beginning of December, but the ants did not cause serious damage. The outturns of grain per acre are above average this season.

Some 500 sowings of wheat were under observation. The plots ranged from $\frac{1}{32}$ to $\frac{1}{4}$ acre area (see statements A, B, C and D).

The plots were long and narrow, and type No. IX (Lal Kale Kasarwali) was again sown at intervals of about 34 yards throughout the area. These plots of type No. 9 served as a standard to indicate any difference in the quality of the soil in different parts of the area. The positions of the standard variety No. 9 with regard to the varieties to be tested were the same as those in the statements A, B, C and D, and when comparing the outturns of the varieties being tested the outturns of the plots of the standard variety on either side should be considered.

Australian wheats (see statement C.)

This year only seven of the best Australian varieties were grown. These were on $\frac{1}{12}$th acre plots. As usual they grew to a good height and did not lodge. All have given satisfactory outturns excepting Mediah which is a tall growing and late ripening variety. It was severely damaged by birds as usually happens to late ripening varieties. An analysis to show the nitrogen contents of the grains of these varieties is now being made.

Selected Indigenous wheats (see statement C.)

Thirteen of the wheat selections made by various people at various times were sown on $\frac{1}{4}$ acre plots this year.

Nine of these which had been found to correspond with the Punjab classified types will now be rejected as they do not appear to be better than the classified types that they represent. Th[illegible]other four selections do not correspond with the Punjab classified wheats and will be further tested.

Punjab classified wheats (see statement A.)

Seeds of each of the classified types of the Punjab wheats sufficient for experiments on field scale having been handed over to a committee composed of Deputy Director of Agriculture, Punjab, Professor of Agriculture, Punjab Agricultural College, and Economic Botanist, Punjab, to discover the localities in the Province which these wheats are specially suited for, the plots on the Botanical experimental area this year were grown chiefly to maintain in the department a stock of pure seeds of these types. The plots were each $\frac{1}{12}$ acre area. All the varieties have given good outturns.

Wadanak wheats (Types Nos. I, II, III) have grown again to a good height. Their outturns range from 22 maunds and 16 seers to 22 maunds and 20 seers. These are the lowest outturns given by the Punjab classified types. As usual these wadanaks did not tiller well.

The dwarf wheats, *i. e.*, (Types 4, 5, 6 and 7) have given outturns of 27 maunds and 24 seers, 24 maunds, 23 maunds and 16 seers, and 23 maunds and 10 seers respectively.

The outturns of the common wheats, *i. e.*, VIII to XV inclusive show the following results :—

Type No.	Mds.	Seers.
XVI	23	16
XXIV	23	16
XV	24	0
XXV	24	30
XX	25	8
XXI	25	8
XIX	25	14
XXIII	26	4
XII	26	4
X	26	22
XIV	26	28
XVIII	27	0
XXII	27	0
XVII	27	24
XIII	27	36
VIII	28	8
IX	29	6
XI	29	28

Stray plants in the plots of pure cultures.

A number of plants, not true to type, were found in the pure culture plots in 1911. The grains from these were grown in November 1911, and the crosses and strays among them identified in May 1912. The presence of stray plants is probably chiefly due to black ants bringing foreign grain into the plots at sowing time. Other agencies also help of course. A record of some years of the number of natural crosses found in these plots will throw some light on the liability to natural cross fertilization in a particular variety.

Crosses of 1910 and 1911.

A plot of about ¾ acre was sown with crosses made in March 1910 and March 1911. These will be selected and properly tested in due course.

Now types of wheats found in the Punjab.

In 1909 a search was started for types of wheat in the Punjab not included in the 25 types of the Punjab classified wheats. Up to date over 20 apparently new types have been discovered. These will be tested in due course.

Cottons.

General.

Cottons were grown on a block of ten acres, set apart for wheat and cotton experiments. The land was left fallow after harvesting the wheat crop in the spring of 1910. With the exception of ¼ acre the area was very regular and good. The cottons grew exceptionally well at first, but in the end of July and in August both desi and American cottons were vigorously attacked by boll-worms. In the month of August early bolls and leaf buds were three times nipped off the plant in order to check the boll-worms. This had a marked effect in checking the disease. As the outbreak of disease occurred in the flowering period and the flowering period of the desi cottons is short, the desi cotton crop was poor. The flowering period of the American cottons is longer and they later managed to form as many new bolls as gave a considerable crop.

Dharwar American Cottons (see statement G.)

Considering the severity of the boll worm attack the outturns of these cottons are wonderfully good. Samples of their lint were sent for valuation and opinion to the Imperial Cotton Specialist, the Chamber of Commerce, Bombay, Messrs. Tata Sons and Co., Cotton Spinners. Bombay, the British Cotton Growing Association, Manchester, and the International Federation of Master Spinners and Weavers, Manchester. In order that the valuations received from the different places might be compared, it was requested that the market prices of Middling, American, Fine Broach, and Good Tinnevelli should be quoted for the day on which the Punja cottons were valued. Valuations have been received from the British Cotton Growing Association, the Chamber of Commerce, Bombay, and Messrs Tata Sons and Co., Spinners, Bombay, see statement F. The Imperial Cotton Specialist informs me that, as I have received valuations from the Chamber of Commerce, Bombay, and Messrs. Tata Sons and Co., Bombay, he has nothing to add regarding these valuations. The Secretary of the Chamber of Commerce, Bombay, in his letter No. 495, dated 16th May 1912, remarks. " The majority of the samples submitted show an excellent spinning cotton. The colour is very white and staple good to very good, some being exceptionally long and silky. The valuations given against the better stapled lots are, however, rather ' nominal ' as it is difficult to give a reliable opinion without having the length and strength of the staple properly tested by machinery in a Mill. The selling price in Bombay would depend a great deal upon the quantity available. If the Bombay Mill Agents could depend upon a large and regular supply of such cotton at a reasonable price they would, no doubt, use it instead of importing Americans on a large scale, as they have done this year. Some of the lots would probably find a better market in Lancashire than India, and a more reliable valuation could be obtained from the Liverpool Cotton Exchange than Bombay, as the members there deal regularly in long-stapled varieties, and consequently know more about the intrinsic value of such cotton than merchants and dealers in Bombay."

The following is an extract from Messrs. Tata Sons and Co.'s letter, dated 10th May 1912, forwarding their valuations :—

" Only one sample out of the 26, *viz.*, No. 161, can be compared with American. It is a splendid cotton, especially in length and strength of its fibre, and every help and encouragement should be given for its cultivation on an extensive scale. If the cultivation of this cotton turns out a commercial success, it will finally solve the problem of obtaining long-stapled cotton from the British territory. . . . . . The other samples are of the Indian style of cotton and have been compared with the cottons of the different localities they most resemble. Tinnevelly cotton is hardly ever used in Bombay and is not quoted in our markets. It is a cotton with distinctive characteristics and different from any cottons from other parts of India. We have, therefore, not taken it in account for comparison."

The Secretary of the British Cotton Growing Association in the letter accompanying the valuations of the Association states : ". The prices mentioned would perhaps be obtainable for shipment from India in this and following months, cost freight and Insurance Liverpool or Continental Ports. It is impossible to tell what ' spot ' value similar kinds would have, to-day stocks in Liverpool being of quite an indifferent character, both as regards quality and quantity with hardly any business doing. . . . On the whole, the quality of the cotton appears to be very good, and anything valued at 6*d* and over would certainly be useful for Lancashire staple trade. . . . . Special mention is made whenever I think the quality suitable for Lancashire."

The valuations received may be compared in statement F. If a mean is taken of the three valuations received the six most highly valued acclimatized American cottons and their valuations are as follows :—

Type.	*Price per Candy of 784 lbs. delivered in Bombay.*
	Rs.
161 A	380
280	333
246	323
111	322
72	320
168	316

It will also be seen that in each of the three valuations received the same six cottons are most highly valued, although they do not stand quite in the same order. No. 161 A is in all three cases first on list. Its percentage of lint to Kapas (unginned cotton) is not as high as might be desired, and its yield of Kapas per acre is also too low this year on the experimental area to allow it to be the most profitable of these types of cotton, from the farmer's point of view. Increased profit per acre is what the farmer should look for in improved cotton, and I have therefore prepared statement G to show the estimated value of lint per acre from these cottons in the past season, the value of the fibre being taken as the mean of the three valuations received. A study of the statement will show that the six cottons which have given the most profitable returns from the farmer's point of view are as follows :—

Type.	*Estimated value of lint per acre.* Rs.	A.	P.
246	123	3	11
110	118	9	2
266	118	7	8
267	115	14	4
233	109	11	10
270	107	15	6

It will be seen that only one of the six cottons whose lint has been most highly valued, *i.e.*, type No. 246, comes into the last mentioned list of six cottons. The yield of cotton Kapas (unginned cotton) per acre is evidently a very important factor in determining the profit per acre, and the plots on which these cottons have been grown in the past year are far too small to enable us to decide rapidly which types of cotton would be most profitable to farmers here. In the very limited area of land at my disposal, however, I was unable to give them larger areas. Owing also to the severe attack of boll-worm last year the results are not as reliable as they would be in ordinary years. The earlier varieties of cotton perhaps suffered the most. It will be seen from statement G that the native cottons in the experimental area were not nearly as profitable as American cottons. Both American and native got practically the same treatment with the exception of one extra irrigation to the American cottons towards the end of harvesting season. The germination and stand of the newly imported upland American cotton is much better than last year, but still very poor. The quality of their lint seems to be deteriorating.

Lately selected and cross plants from the acclimatized cottons.

Three promising plants have been found. One of these, namely, 28 O. F., provided sufficient lint for valuation this year. These selections and crosses will be further tested as soon as possible.

Collection of the Punjab and North-West Frontier Province cottons.

Professor Gammie, Imperial Cotton Specialist, visited Lyallpur on October 1911 to see the collection of cottons from the various districts of the Punjab and North-West Frontier Province. He agrees with the classification which had been made, *viz.*—

Native cottons.	*Agricultural race.*
1. Gossypium sanguinem ...	A.—Broad leaf. B.—Narrow leaf.
Ditto (variety minor) ...	A.—Broad leaf. B.—Narrow leaf.
2. Gossypium herbaceum.	
3. Gossypium indicum.	
Ditto (variety Molisoni).	
4. Gossypium neglectum.	
Ditto (variety Rosea).	

American Cottons.

1. *Gossypium hirsutum.*—The selection of the best agricultural races from an economic point of view is now being proceeded with. It is hoped that a special note on these cottons may be published soon. The very heavy College duties in past years has prevented this up to this date.

Experiment with barley varieties.—The five varieties of barley referred to in statement E were sown this year on a fairly light loam of average quality. The crops previous to the barley were rape and flax. The land had been fallow from March 1911 till October 1911. During that time it received four ploughings. The barley was sown on 7th October 1911. No manure was given. The crop received three waterings and one weeding.

In the early part of the season considerable damage was done to the Kulu barley by white ants. The other barleys were not attacked; otherwise the plots all did very well.

Considerable interest is now being taken in Indian barleys for malting purposes in Europe, and the local price of barley has risen almost to that of wheat in the past half year. The outturns of 35 maunds 12 seers from Lyallpur barley, 38 maunds 28 seers from Lahore barley and 30 maunds from Cape barley make the crop worth consideration. The black barley, a huskless variety which probably came originally from the Baluchistan and Afghanistan side, and the Kulu barley or Spiti barley, a huskless variety from Kulu, probably find the climate of the Punjab plains somewhat trying for them. It is hoped that all these barleys will be analysed and have their malting properties tested in the coming year. Also that a proper survey of the barleys of the province will be taken in hand.

Canal weed—(*Euphorbia thymifolia*).

At the instigation of His Honour the Lieutenant-Governor experiments were started to discover a method of destroying the canal weed (*Euphorbia thymifolia*). This little weed does an extraordinary amount of damage to lawns over a great part of the province. Indeed in a very few years after getting to a lawn it frequently kills out practically all the grass and remains in possession of the ground.

Those who possess lawns will be glad to hear that a method of killing the weed without damaging the grass has been found. The cure consists of common salt and water. Repeated experiments have shown that a solution of 4 to 8 per cent. of common salt in water sprayed on the lawn at the rate of 9 to 12 cwts. per acre, will kill the weed within a few days without affecting the grass. A good serviceable solution to use is one seer of salt to one kerosine tinful (4 gallons) of water, sprayed on an area of 10 square yards. This makes a 5 per cent. solution applied at the rate of 8¾ cwts. of salt per acre. At the above rate 31 seers approximately of salt will be sufficient to spray one tennis court and should cost Re. 1-3-0 approximately where salt costs Re. 1-8-0 per maund.

If there is a very close felt of weed the strength of the solution should be kept as above, but a rather greater amount of liquid should be applied per acre. The lawn should be mowed and the plants should be dry when the spraying is to be done. The work is best done after the sun has risen on a hot day. Rain or irrigation immediately after the salt has been sprayed will spoil the effect. Irrigation may be given 7—10 days after spraying.

In several cases where a stronger solution and a much heavier dressing of salt was applied per acre the grass died down, but came up again immediately after the first irrigation.

Miscellaneous.

Green fodder in April, May and June.

Zamindars inform us that they are badly in want of some crop which will yield green fodder for their cattle during the months of April, May and June.

Some experiments were therefore made on the point during the past year. So far lucerne seems the most promising crop for this purpose. Lucerne grows very well here, and from what I see of it on the few farms around where it has already been tried, and from my wider experience of it in other countries, I would strongly recommend each farmer to grow a small patch of the crop. The usual experience with lucerne is that it comes up rather thinly in the first year, and yields its best results in the second and third years. Farmers therefore usually uproot the crop in the fourth year. The greatest drawback to the crop in Egypt, and in several other countries where it is grown, is that it is extremely liable to be destroyed by the larvæ of certain insects.

The leaves and green parts of the crop may be completely destroyed within a week by these. The most practical cure for an attack of these insects is to cut the crop close to the ground and flood the area with water. Experiments made by me here showed that the larvæ are drowned in by the irrigation water in a very short time, but that if any stray plants in the plot are left uncut, the pests that may be near these will crawl up the stems and escape from the water. The fodder cut on such occasions can be fed to cattle, or if it cannot all be used for that purpose in the fresh green state it can be made into hay. I need hardly say that as lucerne is a leguminous crop it enriches the soil in nitrogen and most excellent crops of cereals can be had after it.

Japan rape seeds.

A plot of Japan rape was grown. It is not very promising.

Grams.

Statement H. shows the result from six varieties of grams sown on ⅛ acre area each.

Maize and jowar varieties.

A number of maize and jowar varieties were grown. Cawnpore white jowar No. 3 and kafir Nos. 19492 and 17569 have been handed over to the farm for further trial. The first-named variety gives some promise of being useful for seed purposes, while the other two may be useful for fodder purposes.

Date palms.

Work on the scheme for improving and extending date cultivation of the province has gone as far as staff and time has allowed. A good deal of information has been collected regarding the quality of dates which have up to the present been grown in the Punjab. It appears that with the exception of those from a very few date trees the fruits are of very poor quality, the reason of this being that the trees are being chiefly grown from seeds and not from the suckers of the best plants, and that the seedlings are not selected in any way when the qualities of their fruits are seen. Indeed date cultivation seems to be carried on in a most careless manner. The fact that a few trees produce excellent fruits shows that excellent fruits could be grown in the Punjab if care is taken to select good trees. Enquiries show that the date palm can be grown successfully at least in the western side of the province, and that it could be made one on the most profitable crops in India. Model plantations have been established in Multan Central Jail, Muzaffargarh District Board Garden and in Dera Ghazi Khan. The Arab date grower who was engaged some two years ago is now assisted by a Mali who is learning the Arab's methods with a view to succeeding him when the Arab returns to his country.

During the past two years about 3,000 off-shoots from the best varieties of Arabian date-palms have been imported from Basara, and the majority of these have been planted in the above-mentioned plantations. The remainder have been supplied by request to the North-West Frontier Province, Bahawalpur State, and Executive Engineers, Multan, Muzaffargarh and Dera Ghazi Khan Canals. About 50 Arabian trees are growing in the botanical area at Ly[illegible]pur. About 12 Arabian date plants planted in September 1910 at the Multan Central Jail and about 5 Arabian date plants planted in September of the same year in the botanical area, Lyallpur, are bearing fruits this season. I have not been able to see the Multan plantation lately, but there are several lovely bunches of date fruits on the Lyallpur plants, and if we do not get too much rain in the next two or three weeks to cause the fruits to drop off the trees or prevent them from ripening properly, we ought to be able within the next few weeks to show to growers ripened fruits from those trees. In the course of my enquiries I have on many occasions been informed that Arabian date plants never form fruits in the Punjab, but the date fruits on our trees are already far past the stage when there can be any doubt on that point. The fruits are already well developed and larger than ordinary varieties grown in the Punjab. The development of fruits on these trees is remarkably early, as suckers are not expected to bear fruits for five years after they are planted out.

Smyran figs.

A brief provisional note for people interested in date cultivation in the Punjab was published during the year. The young trees are doing well. Investigations regarding fertilization of their fruits are being carried on.

Experiments with Scotch potatoe at Mashobra, Simla district.

The experiments are being continued, but the amount of seed is yet too small to give reliable comparativeresults.

D. MILNE,

Economic Botanist, Punjab.

APPENDIX IV.

Annual Report of the Gurdaspur Agricultural Station for the year 1911-12.

Introductory.

Mr. Milligan was in charge of the post of Deputy Director of Agriculture, Punjab, until the 6th May 1912, when he left to join his new appointment at Pusa as Imperial Agriculturist. I took over charge on the 18th of May 1912 from the Assistant Director of Agriculture, Punjab, M. Fateh-ud-Din, who had been acting as Deputy Director in the meantime.

Season and its effect upon the crops.

The total rainfall for the year was 21·45 inches as compared with an average of 34·55 inches for the past 10 years (*vide* statement No. 1). The monsoon rains practically failed and kharif crops suffered in consequence. The season was favourable for the rabi crops. Rains fell at sowing time and winter rains were also favourable, coming at the proper time just after the flowering of the wheat crop.

General.

As stated in last year's report, the Agricultural Station consists of (1) a chahi area, where the sugarcane crop is the chief subject of investigation, and (2) a barani area, where experiments with wheat cultivation are being taken in hand. Each area will be considered separately.

The chahi area.

When this was taken over from the District Board, half the land was under shisham trees and the other half under vegetables, in consequence of which the land is far from uniform. The whole area has been cleared, levelled and laid out into plots. Where possible a crop of *chari* (*Andropogon sorghum*) was taken during the kharif season to test the uniformity of the several plots. Apart from this very little other work was possible in this area. Sugarcane varieties, which had been collected from various parts of India, were grown on a small area in order to propagate sets for next year. Soy beans also were given a trial, but failed, owing partly to bad germination and partly to insect attack when the plants were just coming above ground.

Rotation to be adopted on chahi area.

Thirty acres have been set aside for the work on sugarcane. It is intended to adopt the ordinary three coarse rotation of the district, *viz.*, sugarcane, wheat, maize, with a catch crop of senji (*Melilotus parviflora*) between the maize and the sugarcane crops. In this way 10 acres will each year come under cane.

The effect of harrowing the young chari crop.

One point of interest to be noted in connection with the chari crop this year was the effect produced by passing a light chain harrow over the young crop: the failure of the rains also helped to bring out more clearly than would otherwise have been the case the effect of the harrowing. The harrow not only removed weeds, but produced a fine surface mulch, which prevented the land from drying up, with the result that the farm crop was considerably better than other crops in the vicinity.

The barani area.

During the kharif season test crops were grown on some of the plots which had not already been tested. The land in this area is more uniform in character than in the chahi area, and it was, therefore, possible to commence the following work on wheat this rabi :—

(1) Varietal trials.

(2) Deep and shallow ploughing experiment.

(3) Green manuring.

The results will be saparately considered.

Varietal trials.

The 25 classified types of Punjab wheat were all grown in small plots side by side with a view to find out the types best suited to the district. From statement No. IIA, where the yields are given, it will be seen that types Nos. 13, 14 and 20 have yielded over 30 maunds to the acre. As might be expected these three types are the commonly grown wheats of the district. Type No. 11, which is not at present grown in the district, has given a very high yield, and may possibly prove a useful wheat here. Too much importance must not be attached to the yields, which throughout are high, as the area under each type was only small.

A comparison of types Nos. 13 and 14.

A thorough comparative test of types 13 and 14, the two local barani wheats, was carried out. They were grown in alternate plots (⅓rd acre each) over an area of 10 acres. The yields, therefore, which will be found in statement IIIA may be taken as reliable. No. 13 has given surprisingly good results and has proved itself a better wheat all round than No. 14. It has yielded better and also gives finer bhusa; it is, however, a late-ripening wheat. The very high yields were obtained without any manure and are largely due to the hot weather ploughing and frequent subsequent harrowing during the rains.

Pusa wheats.

Nine Pusa crosses, which were received from the Imperial Botanist for trial on barani land, were grown on areas of about ¼th acre each, Punjab type No. 14 being also grown as a check crop. They were all disappointing, however, with the exception of Pusa 12, a fine early ripening white wheat with a long head, which attracted considerable attention in the neighbourhood amongst zamindars, who were anxious to obtain seed. Like Punjab No. 13 it is a true barani type, that is to say, in the early stages of growth it concentrates all its energy on root development and consequently has a poor appearance. Later on, however, it improved rapidly and gave a yield of 25¾ maunds to the acre (*vide* statement No. IVA.) This wheat will next year be grown on a larger scale and tested with Punjab No. 13. All the other crosses were badly rusted.

Deep and shallow ploughing.

Six small plots were chosen, of which 3 alternate plots were ploughed to a depth of 9 inches, while the other 3 plots were ploughed to a depth of 4½ inches only. Wheat type No. 14 was sown in all the six plots which, with the exception of the ploughing, all received similar treatment subsequently. The yields which are all in favour of deep cultivation are as follows :—

	Yield per acre.	
	Mds.	Srs.
Deep ploughing	25	35
Shallow ploughing	23	37

It was noticed that in the plots, which had been deep ploughed, each head carried more grains to the spikelet than was the case in the shallow ploughed plots.

The first crop after a deep ploughing is often poor owing to the fact that the soil from below, which is brought up to the surface, requires to be exposed to the action of the weather for some time before the plant food contained in it becomes available to the crop. In view of this fact it was thought that gram (*Cicer arietinum*) might be a more suitable crop than wheat to take on newly deep ploughed land. An experiment on exactly similar lines to that of wheat was, therefore, conducted with gram. The yields were as follows :—

	Yield per acre.	
	Mds.	Srs.
Deep ploughing	22	19
Shallow ploughing	20	4

It appears, therefore, from these results that the yields of both wheat and gram are considerably increased on barani land in this district in the first year after deep ploughing.

Green manuring barani wheat with san.

A crop of san (*Crotalaria juncea*) was grown on the chahi area. At harvest time in September the plants were transferred to a small plot of barani land, where they were ploughed in with a Raja plough and wheat was sown in November. The crop, however, was poor, and seemed to suffer more from drought than the other wheat crops on this area. This seems to be due to the fact that a great deal of moisture was consumed in the decomposition of the green leaf. The experiment will be repeated next year.

Harrowing young wheat.

The passing of a light chain harrow over the young wheat crop has this year been tried for the first time, and the high wheat yields which have been obtained are very probably largely due to this. The harrow serves three purposes :—

(1) It breaks up any crust which may have formed over the surface of the soil owing to rains after sowing.

(2) It produces a surface mulch, which prevents loss of moisture.

(3.) It uproots weeds.

Its use will be demonstrated in as many districts as possible next year.

Visitors.

At present the Farm is little known outside the district, but neighbouring zamindars take an interest in the work and the implements especially attract their attention. During April 1912 the Bank Inspector of Gurdaspur district brought a party of zamindars to see the wheat crops, which were a very convincing proof of the economy of using iron ploughs and harrows.

H. SOUTHERN,

Deputy Director of Agriculture, Punjab.

APPENDIX V.

Annual report of the Agricutural Chemist, Punjab, for the year ending July 31st 1912.

Staff.—Four Assistants for the research section and one Demonstrator for the teaching side of the chemical section were sanctioned on the 8th August 1911. The posts were advertised, and there being no suitable applicants from the Punjab, D. K. Ambekar, M. A., from Bombay, and L. Tarak Nath Dass, B. Sc., from United Provinces, were selected, who joined early in December. Bhai Arjan Singh, L. Ag., who was transferred last year to the chemical section for probabtionery training in Chemistry for one of these posts, has been confirmed from 1st January 1912. M. Barkat Ali, L. Ag., who stood first in the Diploma Examination of this College, has been selected to fill up the fourth vacancy, and has been sent to Pusa to qualify himself in soil bacteriology. Bhai Nihal Singh, B. A., joined on 26th October 1911 as Demonstrator, and on 5th February 1912 was replaced by L. Ramji Narain, M. Sc.

The post of Lecturer in Physics and Mathematics was sanctioned for one year, and M. Minaj-ud-din, M. Sc., took charge of the classes on 6th September 1911.

Muhammad Nasir, continues as Lecture Table Assistant.

Much difficulty is experienced in securing suitable laboratory attendants on the sanctioned scale of pay Rs. 10—1—15 per mensem.

Teaching of Chemistry and Physics.—The Assistant Professor Bhai Jagat Singh was given complete charge of the first year class. Lectures in Organic Chemistry to the 2nd year class and in Agricultural Chemistry to the 3rd year class were delivered by the Agricultural Chemist himself in person. Both the classes in practical laboratory work were conducted by the Assistant Professor assisted by the Demonstrator under the Agricultural Chemist's directions and supervision. Particular emphasis is laid on the importance of these practical classes, for some elementary instruction in Practical Science is now generally valued not only as a preparation for a professional career and for many branches of manufacturing industry and enterprises, but also as an important branch of general mental training.

The first year students generally and this year particularly were weak in English and Science, and, as was pointed out last year, this weakness takes at least six months of the College tuition before students begin to grasp what they are taught.

The second year class has made marked progress during the year and gives promise of a successful third year class for the Diploma Examination.

Diploma Examination.—Out of the 10 candidates that appeared for the Diploma Examination 9 passed in Chemistry. Four were recommended for a first class, 2 for second class and 3 for third class. The standard reached is not only higher than the B. Sc. standard of the Punjab University in some respects, but also favourably competes with that of the long-established Agricultural Colleges in other provinces. Mr. G. Clarke, the outside Examiner, remarks that "The answers sent in were of a high order, and shewed evidence of a careful teaching. The paper set was a difficult one concerning the whole field of organic chemistry. The candidates shewed a thorough grasp of the application of organic chemistry to the study of the problems in agriculture and plant physiology. The first two papers were of exceptional merit."

Provincial Chemical Work.—Sugarcane in the Gurdaspur district.—An analytical survey of the sucrose contents of the sugarcane of the Gurdaspur district was undertaken during the months of December, January and February. One of the main objects of the enquiry was to ascertain the possibility of obtaining canes good enough in quality and high enough in yield to offer an opportunity of successfully establishing a central factory for the production of gur or refined sugar. A temporary laboratory was therefore set up at the Gurdaspur Government Farm, and the Deputy Director, Mr. Milligan, made satisfactory arrangements for the bringing in of samples of cane every day. Two hundred and seventy-seven samples of cane from the district were analysed. The sucrose contents of these canes varied between 8·6 to 19·5 per cent. Besides this 24 samples of the sugar products—sakkar and gur—from villagees from where cane samples had been drawn for analyses were also analysed. They were for the most part of a high degree of purity, and in one case reached as high as 80 per cent. of sucrose with no impurities other than invert sugar and moisture. No advice can be given as the result of the experience of one single sugar season, and it is considered necessary to carry out these investigations during at least another two seasons in order to eliminate as far as possible the climatic factor, since the growing season 1911 and the ripening season of 1911-12 have been extraordinarily favourable in the Gurdaspur district. Moreover, it has been found impossible to obtain any reliable figures on the yield of cane per acre, all enquiries in this direction being received with suspicion by the cultivators. This factor is of prime importance, and we shall have to wait until reliable figures on the outturn of the different varieties of canes per acre have been obtained at the Gurdaspur Farm, and this cannot be accomplished in less than 2 or 3 seasons : it may be even more.

Reh.—A report embodying a preliminary survey of the constitution of the alkaline affected soils of the province, together with recommendations for reclamation experiments, has been issued. Artificial drainage to remove the surplus salts appears to be a possible remedy applicable in general. Certain land about three squares situated 59 J. B. near Narwala, at a distance of some nine miles from Lyallpur, has been recommended for draining experiments. This land is badly affected and has gone completely out of cultivation.

Further laboratory investigations have been taken up with a view to measure the lateral movement of surface water and the depth to which drainage exists.

Wheat weevil.—Experiments have been started to find out whether sulphur dioxide or carbon dioxide can be used in preserving grain from the attack of weevil.

General analyses.—Some 50 samples of urinated soils, butter, milk, oil-cakes, etc., have been analysed during the year for inter and extra-departmental purposes.

Meteorological observations at the Agricultural Station, Lyallpur.—Daily meteorological observations have been recorded at the Lyallpur Agricultural Station throughout the year.

Expenditure.—Books of reference for the Chemical section of the Library to a value of Rs. 836-13-2 have been added during the year, while total expenditure of the Chemical Department on the purchase and repairs, etc., of chemicals and apparatus and books amounted to Rs. 5,508-4-4 as compared with the expenditure of Rs. 5,984-15-4 for the last year ending July 31st, 1911.

H. E. ANNETT,

Agricultural Chemist, Punjab, Lyallpur.

APPENDIX VI.

Report on work outside the Agricultural Stations.

1. *Agricultural machinery.*—The production and demonstration of labour-saving machinery has again occupied much time this year. Satisfactory progress has been made, especially in the trials of tillage implements.

(*a*) *Ploughs.*—Improvements have been effected in the " Meston " type of plough by Ransomes, Sims and Jeffries, consequent upon the visit of their representative to this country last year. This improved Meston plough has given general satisfaction, wherever it has been worked; it is also cheap (about Rs. 6), and of lighter draught than the desi plough. Ransomes have also designed a new plough, especially for the Punjab, something after the " Raja " type. This has shown itself satisfactory for certain classes of work. The Department is, therefore, now in position of both cheap and suitable ploughs. The two new Ransomes ploughs will undoubtedly become popular for light work, as they are cheap : the Raja and Punjab types, however, will continue to be required for heavier work. A heavier type of plough for deep cultivation and capable of tackling stiff land is under trial, and promises to prove suitable for reclaiming land infested with dub and other grasses.

(*b*) *Harrows.*—Our experience this year has shown the great importance of paying attention to the after cultivation of crops as well as to the preparation of the land before sowing. It is the recognised custom to hand hoe valuable crops, such as sugarcane, but the cotton and in many places the wheat crop remains practically untouched from sowing to harvest time. An effort has, therefore, been made this year to see what can be done in this direction. A flexible chain harrow has been tried on wheat, and has given most promising results : its use will be demonstrated extensively next year. Two harrows, especially designed for use on the sugarcane crop, have been obtained, but unfortunately did not arrive in time for a trial on this year's crop.

In view of the fact that inter-cultivating implements are practically unknown, an effort was this year made in the Lyallpur colony to demonstrate the sowing of cotton in lines so as to allow of after cultivation between the rows Owing, however, to the failure of the cotton crop this demonstration attracted little attention. The work will be continued next year.

(*c*) *Bullock hoes.*—Bollock hoes, suitable for cultivating between the rows of cotton and maize crops, have been introduced from Gujrat. Each hœ consists of a small iron blade with a wooden frame and handle. Three of these can be yoked to one pair of bullocks, each hœ being guided by a boy with one man to drive the bullocks. Such a gang will hoe from 6 to 8 acres a day. The use of these hœs is now being demonstrated on cotton crops in the Lyallpur colony.

(*d*) *Steam threshing.*—A second steam thresher, with improvements on last year's pattern, was received from Messrs. Ransomes Sims and Jeffries, and was used at Lyallpur this season. Particulars of the running of the machine will, however, be withheld until the cold weather, when Ransomes' representative is visiting Lyallpur to carry out trials.

(*e*) *Reaping machines.*—It was thought that little help would be required this year by owners of reaping machines, except in the case of new purchasers ; results, however, have shown that probably for some time to come the Department's supervision will be necessary. During harvest time our staff were able to visit 109 machines, out of which number 27 were for various reasons not being worked. Some were out of order and had not been sent to the Lyallpur workshop for repairs ; others could not be used on account of badly lodged crops ; while others again were idle owing to trouble with mukhtars (agents) and tenants who earn more when the crop is handcut. It was, however, encouraging to see that zamindars, who work their own land themselves, were all using their machines with success, some cutting as much as 280 and 250 acres during the season.

Outside demonstrations.

2. This work was conducted on similar lines to last year. Much of the staff's time was again taken up in giving demonstrations of the machines and implements at work and in visiting and instructing purchasers of new ploughs and reapers in the proper handling of them. Demonstrations of implements were carried out in the following places :—

Gujranwala ...	Gujranwala district.
Bham ...	Gurdaspur district.
Kalanaur ...	
Faizulla Chak ...	
Mahan Dai ...	
Dhogri. ...	Jullundur district.
Jullundur City ...	
Hoshiarpur	Hoshiarpur district.
Kharar ...	Ambala district.
Morinda ...	

These demonstrations, almost without exception, were successful and attracted considerable attention.

At Hoshiarpur in particular the improved Meston ploughs were much liked and are now being stocked for sale by the different agricultural banks throughout the district.

In Gujranwala district a large area of land has become overrun with dub grass, and is consequently going out of cultivation. A demonstration was, therefore, given in September on a piece of this land to show how it may be reclaimed by a deep ploughing with the Raja plough and the use of a harrow afterwards to clean the lands. The demonstration was successful, and as a result about 35 Raja ploughs were sold in the district. It has not been possible to continue work in this neighbourhood; but as soon as the services of a member of the staff can be spared, he will be posted there temporarily.

A similar demonstration was given in Gurdaspur district, where 30 acres of land were reclaimed for the owners. It has created a demand for iron ploughs in the locality. Ploughs and harrows from the Agricultural Station have, when possible, been given on loan to our neighbours. There was such a demand for the loan of chain harrows for breaking the crust on newly sown wheat fields that zamindars offered to pay as much as Re. 1 per day for their use. Now that the staff of Agricultural Assistants and Mukaddams is increasing, it is intended to conduct organised demonstration work in several districts next year on land belonging to members of village banks.

Wheat survey work.

3. Wheat surveys were carried out during the year in Jullundur, Ferozepore and Attock districts. Distribution of pure seed of the predominating types will be undertaken in these districts as soon as possible.

Wheat No. 9, which was distributed for seed in the Lyallpur colony, has not yielded as well as was expected. It has shown itself to be a wheat which requires really good land and treatment to give good results.

4. *Well-boring.*—Of the 20 boring plants, which have been sanctioned, 18 are now in use; the remaining 2 will come into use as soon as the borers have gained sufficient experience to be put in charge of plants.

Distribution of work.—The work has been split up into three circles, each of which contains three districts and is under the control of a supervisor as follows:—

Rewari	Gurgaon. Rohtak. Hissar.
Ambala	Ludhiana. Ambala. Karnal.
Jullundur	Jullundur. Hoshiarpur. Gurdaspur.

The year's work.—During the year 309 wells have been bored and 17 trial borings made. Of the 309 wells bored the water-supply has been increased in 165 cases, while 9 of the trial borings were successful.

In the Rewari circle the results have been very successful showing over 80 per cent. of successful borings. In the other two circles, however, there were more difficulties to contend with, the spring level being often very low.

Causes of failure.—The failures were nearly always due to one cause, namely, the low spring level. In some cases the boring plants were not capable of going to the required depth, while in other cases where water would probably have been tapped had the work been continued the borings had to be stopped, as the well owners were not willing to risk any more money.

It seems advisable, therefore, to procure one or two deep boring plants and with these to conduct trial borings in districts, where the underground water-supply is at a low level. Once the level and strength of the springs are known, owners of wells will be able to decide whether a deep boring is likely to be economical or not. This point is, at present, under consideration. Another point, which is also receiving consideration is the purchase of rock-boring plant, as in all cases, where rock was encountered, as, for instance, some trial borings at the site of the new capital at Delhi, the borings had to be stopped as the present tools are unable to tackle rock.

Staff.—Considering that the staff are new to their work and that conditions even within a radius of a few miles often differ very considerably, the progress of the work has been satisfactory, and much valuable experience has been gained.

The control of the supervisors and borers have been in the hands of the Assistant Director of Agriculture, who has capably managed the heavy inspection and office work which this entails. Appended is a statement showing the districts where work has been carried out.

No.	Name of district.	Existing and proposed wells.		Remarks.
		Number of borings.	Successful.	
1	Gurgaon	37	33	Five of these were trial borings : four success
2	Rohtak	36	30	
3	Hissar	6	2	Two of these were trial borings : both failed.
4	Delhi	5	...	All trial borings.
5	Jind State	1	...	Incomplete.
6	Karnal	55	36	Two trial borings : both successful.
7	Ambala	13	3	One trial boring : successful.
8	Ludhiana	25	11	
9	Jullundur	37	18	Two trial borings : both successful.
10	Hoshiarpur	27	10	
11	Gurdaspur	68	26	
2	Gujrat	12	3	
13	Rawalpindi	3	2	

H. SOUTHERN,

Deputy Director of Agriculture, Punjab.

STATEMENT I.

Showing rainfall at the Lyallpur Agricultural Station during the year 1911-12.

MONTH.		1911-12.		1910-11.		REMARKS.
		Number of rainy days.	Rainfall in inches.	Number of rainy days.	Rainfall in inches.	
June 1911 ...	1st half ...	1	·71	2	2·28	
	2nd „ ...	2	1·92	3	3·14	
July 1911 ...	1st half ...	1	·32	...	...	
	2nd „ ...	...	...	2	1·72	
August 1911 ...	1st half ...	...	...	2	1·89	
	2nd „ ...	2	1·47	5	5·64	
September 1911	1st half ...	...	...	...	...	
	2nd „ ...	1	·25	...	...	
October 1911...	1st half ...	1	·25	...	...	
	2nd „ ...	...	...	...	...	
November 1911	1st half ...	1	·25	...	...	
	2nd „ ...	...	...	...	...	
December 1911	1st half ...	...	...	1	·12	
	2nd „ ...	...	...	...	...	
January 1912...	1st half ...	...	...	5	1·03	
	2nd „ ...	2	1·63	1	·16	
February 1912	1st half ...	...	...	...	...	
	2nd „ ...	...	...	...	...	
March 1912 ...	1st half ...	...	...	11	2·37	
	2nd „ ...	...	...	2	·53	
April 1912 ...	1st half ...	2	·28	...	...	
	2nd „ ...	5	·65	1	·71	
May 1912 ...	1st half ...	...	...	2	·16	
	2nd „ ...	...	...	...	...	
Total ...		18	7·73	37	19·75	

STATEMENT No. II.

Statement showing the outturn of maize grown in the manurial and rotation series at the Lyallpur Agricultural Station in Kharif 1911.

No. of square.	No. of plot.	Name of variety.	Treatment.	AREA.		WEIGHT OF DRY STALKS.			WEIGHT OF DRY COBS.			WEIGHT OF GRAIN.			WEIGHT OF TUKKAS.			WASTAGE IN BEATING.			YIELD PER ACRE.			REMARKS.
				Kanals.	Marlas.	Maunds.	Seers.	Chattacks.	Maunds.	Seers.	Chattacks.	Maunds.	Seers.	Chattacks.	Maunds.	Seers.	Chattacks.	Maunds.	Seers.	Chattacks.	Maunds.	Seers.	Chattacks.	
	C/1																							
27	1	Red local maize.	Fallow	4	0	13	31	0	15	27	0	12	37	0	2	20	0	0	10	0	25	34	0	Ploughings ... 1 Harrowings ... 22 Hoeings ... 4 Waterings ... 5 Date of sowing, 3rd August 1911. Date of harvesting, 3rd December 1911.
	2		Residues of crude nitre at 495 lbs. per acre.	4	0	14	26	0	16	29	2	13	20	8	2	37	6	0	11	4	27	1	0	
	3		Residues of crude nitre at 990 lbs. per acre.	4	0	16	39	0	19	13	0	15	39	0	3	2	0	0	12	0	31	38	0	
	4		Fallow	4	0	18	0	0	19	11	6	15	14	2	3	25	8	0	11	12	30	28	4	

STATEMENT No. III.

Showing the results of sugar-cane grown in the manurial and rotation series at the Lyallpur Agricultural Station in kharif 1911.

No. of square.	No. of plot.	AREA.		Name of variety.	Treatment.	WEIGHT OF GREEN TOPS.			WEIGHT OF CANES.			WEIGHT OF JUICE.			ACTUAL WEIGHT OF GUR.			OUTTURN OF GUR PER ACRE.			Percentage of green tops to canes.	Percentage of juice to canes.	Percentage of juice to gur.	Percentage of gur to cane.	REMARKS.
		Kanals.	Marlas.			Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.					
27	C 2 1	4	...	Katha.	Farm yard manure at 15 tons per acre and crude nitre @ 691·5 lbs., containing 65 lbs. nitrogen per acre.	103	31	0	148	7	0	80	16	0	13	17	8	26	35	0	70·03	54·26	16·71	9·06	Ploughing, 1. Harrowings, 4. Levellings with Sohaga, 4. Sohaga after sowing, 5. Chain harrow, 1. Waterings, 13. Hoeing and weeding, 3. Crushing began on 9th January 1912. Finished on 24th February 1912.
	2	4	...		Farm yard manure at 15 tons per acre and basic nitrate of lime @ 532 lbs, conatining 65 lbs. nitrogen per acre.	110	34	7	180	0	0	101	26	9	18	11	...	36	22	0	61·58	56·48	17·97	10·15	
	3	4	...		Farm yard manure at 15 tons per acre.	83	32	10	111	10	8	60	24	9	10	38	7	21	36	14	75·33	54·47	18·07	9·85	
	4	4	...		Farm yard manure at 15 tons per acre.	82	15	...	121	3	..	62	20	0	12	25	...	25	10	...	68·03	51·62	20·20	10·42	

Statement No. IV.

Statement showing the residual effects of manures on farm-selected cotton grown in the manurial rotation series at the Agricultural Station, Lyallpur.

No. of square.	No. of plot.	Name of variety.	Treatment	Area.		Actual outturn.			Yield, per acre.			Remarks.
				Kanals.	Marlas.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	
27 C/3	1	Farm-selected cotton.	Residues of castor cake at 10½ cwts. per acre *plus* crude nitre at 495 lbs. per acre.	4	0	1	38	14	3	37	12	Ploughing ... ... 1 Harrowing ... ... 4 Levelling with *sohaga* ... 5 Weeding and hoeing ... 8 Waterings ... ... 7 Picking began on 8th October 1911. " finished on 12th January 1912.
C/3	2		Residues of castor cake at 10½ cwts. per acre *plus* basic nitrate of lime at 1560 lbs. per acre.	4	0	2	21	12	5	3	8	
C/3	3		Residue of castor cake at 10½ cwts. per acre...	4	0	2	32	14	5	25	12	
C/3	4		Ditto ...	4	0	1	33	5	3	26	10	

STATEMENT No. V.

Statement showing the outturn of maize grown at the Lyallpur Agricultural Station in the manurial block, standard kharif, area D, square 27, in kharif 1911.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area, in acres.	Weight of fresh cobs.	Weight of dry cobs.	Weight of dry stalks.	Weight of grain.	Weight of tukkas.	Wastage in beating.	Yield, per acre.	REMARKS.
					Md. S. C.	Md. S. C.	Md. S. C.	Md. S. C.	Md. S. C.	Md. S. C.	Md. S. C.	
D 27— K	12	Red local maize.	Unmanured	$\frac{37}{1320}$	0 23 8	0 19 8	0 9 0	0 14 0	0 3 8	0 2 0	12 19 7	Ploughings ... 3 Harrowings ... 18 Weeding and hoeing... 5 Waterings ... 5 Date of sowing ... 6th August 1911. Date of harvesting ... 25th November 1911.
	13		Calcium cynamide at 3 cwt. 60·7 lbs. per acre.	$\frac{1}{5}$	10 26 10	8 1 0	7 29 0	6 25 14	1 12 13	0 2 5	33 9 6	
	14		Unmanured	$\frac{37}{660}$	2 27 0	2 1 12	1 27 0	1 27 15	0 11 10	0 2 3	30 12 14	
	15		Calcium nitrate at 4 cwt. 101·9 lbs. per acre.	$\frac{1}{5}$	10 38 0	7 29 8	7 18 0	6 16 13	1 10 0	0 2 11	32 4 1	
	16		Unmanured	$\frac{37}{660}$	2 24 0	2 1 0	1 26 0	1 26 12	0 12 10	0 1 10	29 30 10	
	17		Farmyard at 4 tons per acre ...	$\frac{1}{5}$	8 19 8	6 24 15	6 10 0	5 13 7	1 8 8	0 3 0	26 27 3	
	18		Unmanured	$\frac{37}{660}$	1 31 4	1 20 8	1 9 0	1 3 11	0 14 9	0 2 4	19 24 13	
	19		Ammonium sulphate at 318 lbs. per acre.	$\frac{1}{5}$	11 25 0	8 30 8	6 29 0	7 15 0	1 9 8	0 6 0	36 35 0	
	20		Unmanured	$\frac{37}{660}$	2 30 0	2 5 9	1 27 0	1 30 0	0 13 8	0 2 1	31 8 10	
	21		Gypsum at 5 cwts. per acre ...	$\frac{1}{5}$	11 12 0	8 36 5	7 5 0	7 15 12	1 17 10	0 2 15	36 35 12	
	22		Unmanured	$\frac{37}{1320}$	0 27 0	0 20 0	0 17 0	0 15 8	0 2 8	0 2 0	13 32 15	

STATEMENT NO. VI.

Showing the outturn of sugarcane grown in manurial block, standard kharif, area $\frac{D}{K}$ *square 27 in kharif* 1911.

No. of square.	No. of plot.	Area in acres.	Variety.	Treatment.	Weight of green tops.			Weight of canes.			Weight of juice.			Weight of gur.			Outturn of gur per acre.			Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	RAMARKS.
					Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Acres.	Acres.	Acres.	Acres.	
27	1	$\frac{37}{1320}$	Katha.	Unmanured	0	5	0	0	2	0	0	1	0	0	0	3½	0	7	13	250	50	21·87	10·93	Ploughings 3
	2	$\frac{1}{5}$		Superphosphate at 231 lbs. per acre.	19	35	0	21	35	0	11	27	0	2	11	0	11	15	0	90·85	53·37	19·48	10·44	Harrowings 12
	3	$\frac{37}{660}$		Unmanured	8	13	0	9	20	0	4	34	10	0	36	0	16	2	2	87·68	51·18	18·49	9·47	Levelling with sohaga ... 10
	4	$\frac{1}{5}$		Bone meal at 2 cwts. and 80 lbs. per acre.	35	24	0	31	27	0	16	31	0	3	3	0	15	15	0	88·97	52·95	18·33	9·70	Chain harrow ... 1 Waterings 15
	5	$\frac{37}{660}$		Unmanured	8	12	0	9	22	0	5	12	0	0	38	0	16	37	13	86·91	55·49	17·92	9·94	Weeding and hoeings ... 4
	6	$\frac{1}{5}$		Farm yard manure at 4 tons per acre.	37	22	0	37	33	0	20	5	0	3	28	12	18	23	12	99·27	53·20	18·47	9·50	Crushing began on 6th January 1912.
	7	$\frac{37}{660}$		Unmanured	9	33	0	9	19	0	5	0	8	0	35	8	15	33	3	103·69	52·90	17·70	9·36	Finished on 19th January 1912.
	8	$\frac{1}{5}$		Basic slag at 8 maunds per acre.	39	7	0	38	15	0	21	38	4	4	7	0	20	35	0	102·08	57·21	19·01	10·87	
	9	$\frac{37}{660}$		Unmanured	8	17	0	9	20	0	5	36	0	1	7	8	21	7	4	88·68	62·10	20·97	12·5	
	10	$\frac{1}{5}$		Lime at 5 cwts. per acre ...	33	5	8	35	14	8	18	8	10	3	22	8	17	32	8	93·73	51·51	19·55	10·07	
	11	$\frac{37}{1320}$		Unmanured	3	20	0	2	27	0	1	15	0	0	9	0	8	1	1	130·84	51·40	16·36	8·41	

STATEMENT NO. VII.

Showing the outturn of cotton grown in the manurial block, standard kharif, area D, square 27, in kharif 1911, at Lyallpur Agricultural Station.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Actual outturn.			Outturn per acre.			Remarks.
					Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	
27	23	Hansi cotton.	Unmanured	$\frac{37}{1320}$	0	12	10	11	10	6	Ploughings 8
	24		Bone meal at 2 cwts. and 80 lbs. per acre ... Lime at 5 cwts. per acre	$\frac{1}{5}$	1	16	0	7	0	0	Harrowings 13
	25		Unmanured	$\frac{37}{660}$	0	15	11	6	39	13	Levelling with Sohaga ... 11
	26		Ammonium sulphate at 318 lbs. per acre ... Lime at 5 cwts. per acre	$\frac{1}{5}$	2	0	10	10	3	2	Weeding and hoeings ... 10
	27		Unmanured	$\frac{37}{660}$	0	14	7½	6	18	4	Waterings 8
	28		Farm yard at 4 tons per acre	$\frac{1}{5}$	1	22	11	7	33	7	Picking began on 12th October 1911.
	29		Unmanured	$\frac{37}{660}$	0	12	3	5	17	6	Finished on 12th January 1912.
	30		Bone meal at 2 cwts. and 80 lbs. per acre ... Lime at 5 cwts. per acre ... ... Ammonium sulphate at 318 lbs. per acre ...	$\frac{1}{5}$	2	5	9	10	27	13	
	31		Unmanured	$\frac{37}{660}$	0	18	6	8	7	9	
	32		Superphosphate at 231 lbs. per acre ... Calcium nitrate at 4 cwts. and 101·9 lbs per acre. Ammonium sulphate at 318 lbs. per acre ...	$\frac{1}{5}$	2	5	8	10	27	8	
	33		Unmanured	$\frac{37}{660}$	0	16	1	7	6	7	
	34		Non-experimental plot	$\frac{1}{4}$	1	29	8	6	38	0	

STATEMENT No. VIII.

Statement showing the outturn of gram in the manurial series, standard R, area D, square 27, at the Lyallpur Agricultural Station, rabi 1911-12.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	Actual outturn of grain and bhusa.						Yield of grain per acre.			Yield of bhusa per acre.			Remarks.
					Grain.			*Bhusa.*									
					Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	
27—D R	23	Local gram.	Unmanured	37/1320	0	15	8	0	19	0	13	32	15	16	37	13	Ploughings ... 2
	24		1. Bone meal at 2 cwt. 80 lbs. per acre. 2. Lime at 5 cwt. per acre ...	1/5	4	3	8	5	27	0	20	17	8	28	15	0	Harrowings ... 18
	25		Unmanured	37/660	0	36	0	0	30	0	16	2	7	13	15	2	Levelling with sohaga 3
	26		Lime at 5 cwts. per acre and ammonium sulphate at 318 lbs. per acre.	1/5	3	14	0	2	17	0	16	30	0	12	5	0	Weeding and hoeing ... 3
	27		Unmanured	37/660	0	29	0	0	28	0	12	37	5	12	19	7	Waterings ... 2
	28		Farmyard manure at 4 tons per acre.	1/5	2	34	8	3	21	0	14	12	8	17	25	0	Date of sowing. 1st October 1911.
	29		Unmanured	37/660	0	38	0	0	34	0	16	37	13	15	6	8	Date of harvesting. 1st April 1912 to 3rd April 1912.
	30		1. Bone meal at 2 cwt. and 80 lbs. per acre. 2. Lime at 5 cwt. per acre ... 3. Ammonium sulphate at 318 lbs. per acre.	1/5	3	12	0	5	29	0	16	20	0	28	25	0	
	31		Unmanured	37/660	0	39	0	7	11	0	17	15	10	22	29	12	
	32		1. Superphosphate at 231 lbs. per acre. 2. Calcium nitrate at 4 cwt. and 101·9 lbs. per acre. 3. Ammonium sulphate at 318 lbs. per acre.	1/5	3	8	0	7	2	0	16	0	0	35	10	0	
	33		Unmanured ...	37/1320	0	29	0	2	1	0	25	34	9	72	10	0	

STATEMENT No. IX.

Statement showing the outturn of Toria grown in the manurial series standard R., area D., square 27 at the Agricultural Station, Lyallpur.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	Grain.			Straw.			Yield of grain per acre.			Remarks.
					Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	
$27\frac{D}{R}$	12	Toria.	Unmanured	$\frac{37}{1320}$	0	21	0	1	15	0	18	29	3	Ploughings 2
	13		Calcium cynamide at 3 cwt. 60·7 lbs. per acre.	$\frac{1}{5}$	4	21	8	7	21	0	22	27	8	Harrowings 15
	14		Unmanured	$\frac{37}{660}$	1	0	0	2	5	7	17	33	8	Levelling with Sohaga ... 1
	15		Calcium Nitrate at 4 cwt. 101·9 lbs. per acre.	$\frac{1}{5}$	3	29	8	7	3	0	18	27	8	Sohaga after sowing ... 1
	16		Unmanured	$\frac{37}{660}$	0	33	0	1	32	0	14	28	10	Chain harrow 1
	17		Farm yard manure at 4 tons per acre.	$\frac{1}{5}$	4	35	0	7	5	0	24	15	0	Waterings 5
	18		Unmanured	$\frac{2}{55}$	0	29	0	1	16	0	19	37	8	Date of sowing, 4th of September 1911.
	19		Ammonium Sulphate at 318 lbs. per acre.	$\frac{1}{5}$	4	16	0	7	35	0	22	0	0	Date of harvesting, 27th of January 1912.
	20		Unmanured	$\frac{37}{660}$	0	28	0	1	25	0	12	19	7	
	21		Gypsum at 5 cwt. per acre ...	$\frac{1}{5}$	3	2	0	5	25	0	15	10	0	
	22		Unmanured	$\frac{37}{1320}$	0	13	0	0	26	0	11	23	9	

Statement No. X.

Statement showing the outturn of wheat grown in the manurial series, standard R, area D, square 27, at the Agricultural Station, Lyallpur.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area, in acres.	Actual outturn.						Outturn, per acre.						Remarks.
					Grain.			Bhusa.			Grain.			Bhusa.			
					Mds.	Srs.	Chks.	Mds.	Srs.	Chks.	Mds.	Srs.	Chks.	Mds.	Srs.	Chks.	
27 $\frac{D}{R}$	1	Wheat, type No. 9.	Unmanured	$\frac{37}{1320}$	...	14	8	1	20	8	12	37	5	53	38	6	(1) Ploughings ... ... 2 (2) Harrowings ... ... 18 (3) Chain harrow ... ... 1 (4) Weeding and hoeing ... 1 (5) Waterings ... ... 3 (6) Date of sowing, 5th November 1911. (7) Date of harvesting, 18th & 19th of April 1912.
	2		Superphosphate @ 231 lbs. per acre	$\frac{1}{5}$	4	12	...	16	22	...	21	20	...	82	30	...	
	3		Unmanured	$\frac{37}{660}$	1	11	...	4	33	...	22	29	12	86	2	12	
	4		Bone meal at 2 cwts. and 80 lbs. per acre. ...	$\frac{1}{5}$	5	3	...	18	21	...	25	15	...	92	25	...	
	5		Unmanured	$\frac{37}{660}$	1	5	...	5	7	...	20	2	11	92	12	6	
	6		Farm yard manure at 4 tons per acre	$\frac{1}{5}$	5	12	...	19	15	...	26	20	...	96	35	...	
	7		Unmanured	$\frac{37}{660}$	1	16	...	5	6	...	24	38	14	90	38	14	
	8		Basic slagat 8 mds. per acre	$\frac{1}{5}$	5	14	...	19	6	...	26	30	...	95	30	...	
	9		Unmanured	$\frac{37}{660}$	1	8	...	5	13	...	21	16	3	94	39	7	
	10		Lime @ 5 cwts. per acre	$\frac{1}{5}$	5	25	...	17	22	...	28	5	...	87	30	...	
	11		Unmanured	$\frac{37}{1320}$	...	27	8	2	19	8	24	21	...	88	29	12	

Statement No. XI.

Showing the result of variety experiments with sugarcane at the Lyallpur Agricultural Station in Kharif 1911.

No. of square.	No. of plot.	Area.	Variety.	Treatment.	Weight of green tops.			Weight of canes.			Weight of juice.			Actual weight of gur.			Outturn of gur per acre.			Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	Remarks.
					Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.					
13	11	2 Kanals	Katha ...	Farmyard manure at 15 tons per acre.	40	31	...	50	8	...	29	15	10	5	4	...	20	16	...	81·22	58·54	17·35	10·16	
	11	Ditto	Dhaulu ...	Ditto	45	36	...	57	31	...	30	...	...	5	18	8	21	34	...	79·44	51·92	18·20	9·49	
	12	Ditto	Kahu ...	Ditto	47	18	...	73	2	...	46	15	4	6	39	4	27	37	...	64·95	63·49	15·05	9·55	

Ploughing	... ...	1
Harrowings	... ...	6
Levelling with sohaga	...	3
Sohaga after sowing	...	5
Hoeings and weedings	...	3
Waterings	... ...	17

Crushing began on (1) 25th December 1911.
(2) 29th December 1911.
(3) 5th February 1912.
Crushing finished on (1) 28th December 1911.
(2) 31st December 1911.
(3) 8th February 1912.

Statement No. XII.

Statement showing the results of Poona pan versus *Punjab pan.*

Date.	Poona pan.								Punjab pan.							
		Time.		*Weight of fuel consumed.*		*Boiling.*				*Time.*		*Weight of fuel consumed.*		*Boiling.*		
	No. of times boiled.	Crushing started at	Crushing finished at	Maunds.	Seers.	Started at	Finished at	Total time.	No. of times boiled.	Crushing started at	Crushing finished at	Maunds.	Seers.	Started at	Finished at	Total time.
		H. M.	H. M.			H. M.	H. M.	H. M.		H. M.	H. M.			H. M.	H. M.	H. M.
6th February 1912 ...	12	10 38	2 30	3	0	2 30	6 0	3 30	4	9 23	10 38	1	24	10 38	12 5	1 27
7th February 1912 ...	12	7 0	12 0	3	0	12 0	3 30	3 30	4	5 30	7 0	1	16	7 0	9 30	2 30
8th February 1912 ...	12	8 10	1 10	3	37	1 10	5 0	3 50	4	7 0	8 0	1	28	8 0	10 10	2 10
				9	37			10 50				4	28			6 7
			Average ...	3	12						Average ...	1	23		Average ...	2 2
						Average per boiling ...	3 37									

STATEMENT No. XIII.

Spacing experiment with Hansi cotton in square 26 at the Agricultural Station, Lyallpur, kharif 1911.

No. of square.	No. of plot.	AREA.		ACTUAL OUTTURN.			OUTTURN, PER ACRE.			REMARKS.
		Kanals.	Marlas.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	
$\frac{26}{A\text{-}2}$ ...	1	3	...	2	20	7	6	27	13	1½ times of the usual distance, *i.e.*, 42″.
$\frac{26}{A\text{-}2}$ ...	2	3	...	2	36	2	7	29	11	Usual distance, *i.e.*, 28″.
$\frac{26}{A\text{-}2}$ ...	3	3	...	2	35	15	7	29	2	⅔rds of the usual distance, *i.e.*, 18″.

STATEMENT No. XIV.

Different methods of sowing cotton at the Lyallpur Agricultural Station in Kharif 1911.

No. of square and plot.	Variety.	Method of sowing.	AREA.		ACTUAL OUTTURN.			OUTTURN PER ACRE.			REMARKS.	
			Kanals.	Marlas.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.		
$\frac{7}{19}$ ...	Hansi cotton ...	Sowing in lines at 2′ 4″ distance.	4	11	3	5	1½	5	20	0	Hoeing with hand hoe ... ... Ditto cultivator ... ... Ditto drill harrow ...	2 2 1
$\frac{7}{21}$ ..	Ditto ...	Broad cast ...	4	11	2	14	1	4	5	5	Hoeing with native plough ...	1
$\frac{6}{17}$ ...	Type No. 3 F. American.	Ditto ...	9	11	8	30	14½	7	13	15	Ditto ditto ...	1
$\frac{6}{18}$ ...	Ditto.	Sowing in lines at 3 feet distance.	9	2	11	0	15½	9	27	11	Hoeings with hand hoe ... ... Ditto planet junior cultivator Ditto drill harrow ...	2 2 1

STATEMENT NO. XV.

Statement showing the water requirements of Desi and American cottons.

Square and plot.	Name of variety.	AREA OF EACH PLOT.		ACTUAL OUT-TURN.			OUTTURN PER ACRE.			Number of waterings.	REMARKS.
		Kanals.	Marlas.	M.	S.	Ch.	M.	S.	Ch.		
$\frac{13}{7}$	Hansi	8	13	5	13	$\frac{21}{22}$	4	37	0	8	
$\frac{13}{19, 22}$	American Type No. 3 F.	18	0	18	33	12	8	15	0	9	

STATEMENT No. XVI.

Calcium nitrate experiment with wheat at the Lyallpur Agricultural Station.

Square 7, Rabi 1911-12. Variety—Daud Khani.

No. of square and Killa.	No. of plots.	MANURED.					No. of square and Killa.	No. of plots.	UNMANURED.				INCREASE.				Increased revenue value of grain at Rs. 2-12-0 per maund and Bhusa at Re. 0-4-0 per maund.	Expenditure at Rs. 9-10-9 per maund.	Deficit.	REMARKS.
		Calcium nitrate per acre.	AVERAGE OUTTURN PER ACRE.						AVERAGE OUTTURN PER ACRE.				PER ACRE OF							
			Grain.		*Bhusa.*				*Grain.*		*Bhusa.*		*Grain.*		*Bhusa.*					
			Maunds.	Seers.	Maunds.	Seers.			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Rs. A P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
$\frac{7}{8}$	1	168 lbs.	17	2	49	30	$\frac{7}{8}$	2	13	34	36	22	3	8	13	8	12 1 6	19 13 0	7 11 6	
$\frac{7}{8}$	4	168 ,,	19	28	52	16	$\frac{7}{8}$	3	14	38	38	10	4	30	14	6	16 9 7	19 13 0	3 3 5	
$\frac{7}{9}$	2	112 ,,	20	34	54	30	$\frac{7}{9}$	1	14	36	38	12	5	38	16	18	21 7 7	13 3 4	...	Saving ... 7 4 3
$\frac{7}{9}$	3	112 ,,	20	38	55	26	$\frac{7}{9}$	4	15	8	39	0	5	30	16	26	19 15 7	13 3 4	...	Do. ... 6 12 3
																				1. Ploughings ... 2 2. Harrowings ... 5 3. Hoeing and weeding 1 4. Waterings ... 3 5. Date of sowing—3rd November 1911. 6. Date of harvesting—30th April to 1st May 1912.

Statement No. XVII.

Statement showing the residual effects of calcium nitrate on wheat crop grown at the Lyalipur Agricultural Station in Rabi 1911-12.

MANURED.										UNMANURED,									
No. of square and plot.	Area.		Variety of wheat.	Treatment.	Outturn per Acre.				Remarks.	No. of square and plot.	Area.		Variety of wheat.	Treatment.	Outturn per Acre.				Remarks.
					Grain.		*Bhusa.*								*Grain.*		*Bhusa.*		
	Kanals.	Mar'las.			Maunds.	Seers.	Maunds.	Seers.			Kanals.	Mar'las.			Maunds.	Seers.	Maunds.	Seers.	
$\frac{13}{6}$	4	11	9 A 2	Residues of calcium nitrates at one maund per acre.	17	7	60	18		$\frac{13}{6}$	4	11	9 A 2	No manure.	17	14	52	35	
$\frac{13}{6}$	4	11	9 E 1		20	9	74	10		$\frac{13}{7}$	4	11	9 E 1		19	14	58	6	
$\frac{13}{8}$	4	13	IX		21	8	64	38		$\frac{13}{8}$	4	13	IX		18	13	52	3	
$\frac{13}{9}$	4	13	IX		20	39	56	39		$\frac{13}{9}$	4	13	IX		23	18	63	2	
$\frac{13}{10}$	4	9	IX		19	4	52	14		$\frac{13}{10}$	4	9	IX		19	5	45	1	

STATEMENT No. XVIII.

Statement showing the results of Desi versus *Raja plough at the Lyallpur Agricultural Station in Rabi* 1911-12.

RAJA PLOUGH.

No. of square.	No. of plot.	Variety of wheat.	Area.		Actual outturn.				Outturn per acre.				Remarks.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
29	1	Type No. XI.	3	14	6	1	10	31	13	1	23	12	Ploughings 2 Harrowings 9 Levelling with sohaga 3. Chain harrow 1. Hoeing and weeding 1. Waterings 3. Date of sowing, 10-12th November 1911. Date of harvesting, 30th April 1912 1st May 1912.
29	4		3	14	8	30	19	6	18	37	41	16	
29	5		3	14	9	5	21	25	19	24	46	30	
29	6		3	14	7	22	17	13	16	13	37	18	
29	9		3	14	5	8	11	26	11	10	25	8	

DESI PLOUGH.

No. of square.	No. of plot.	Variety of wheat.	Area.		Actual outturn.				Outturn per acre.				Remarks.
					Grain.		Bhusa.		Grain.		Bhusa.		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
29	2	Type No. XI.	3	14	6	19	13	5	24	0	28	15	Ploughings 5. Levelling with sohaga 3. Chain harrow 1. Hoeing and weeding 1. Waterings 3.
...	3		3	14	8	15	16	19	18	5	35	25	
...	7		3	14	9	10	18	33	20	0	40	28	
...	8		3	14	8	37	19	28	19	12	42	24	

STATEMENT No. XIX.

Statement showing the results of Desi versus *Raja plough with Tenants at the Lyallpur Agricultural Station in rabi* 1911-12.

RAJA PLOUGH.

No. of square.	No. of plot.	Variety of wheat.	Area.		Actual out-turn.				Outturn per acre.				Remarks.
					Grain.		*Bhusa.*		*Grain.*		*Bhusa.*		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
7	22	Lal Kasar Wali.	3	19	12	6	23	37	24	25	48	18	Ploughings ... 2 Harrowings ... 4 Hoeing ... 1 Waterings ... 2 Date of sowing 6th to 7th November 1911. Date of harvesting 23rd to 26th April 1912.
7	23	Ditto.	4	10	11	9	25	4	19	38	44	25	
7	24	Ditto.	[illegible]	9	8	36	18	0	16	0	32	14	
7	25	Ditto.	4	1	10	36	29	2	21	21	57	15	
12	17	Type No. XI	4	9	7	6	13	15	12	34$\frac{1}{8}$	24	2	Ploughings ... 2 Harrowings ... 3 Weeding and hoeing ... 1 Waterings ... 4 Date of sowing, 4th November 1911. Date of harvesting 21st April 1912.
12	18	Ditto.	4	11	9	22	21	...	16	31$\frac{5}{8}$	36	37	
		Total ...	...	...	...	...	...	...	111	29	...	...	

DESI PLOUGH.

No. of square.	No. of plot.	Variety of wheat.	Area.		Actual out-turn.				Outturn per acre.				Remarks.
					Grain.		*Bhusa.*		*Grain.*		*Bhusa.*		
			Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
7	22	Lal Kasar Wali.	3	19	11	38	26	16	24	8	53	19	Ploughings ... 2 Harrowings ... 4 Hoeing ... 1 Waterings ... 2 Dated of sowing 6th—7th November 1911. Date of harvesting 23rd—26th April 1912.
7	23	Ditto.	4	6	10	14	23	36	19	10	44	18	
7	24	Ditto.	4	9	9	13	26	29	16	30$\frac{1}{2}$	48	2	
7	25	Ditto.	4	1	8	34	21	21	17	19	42	21	
12	17	Type No. XI	4	9	8	31	21	30	15	31	39	4	Ploughings ... 2 Harrowings ... 3 Weeding and hoeing ... 1 Waterings ... 4 Date of sowing 4th November 1911. Date of harvesting 21st April 1912.
12	18	Ditto.	4	11	8	33	18	13	15	20$\frac{5}{8}$	32	9	

STATEMENT No. XX.

Showing the result of Hot weather versus *Rain ploughing at the Lyallpur Agricultural Station in Rabi* 1911-12.

HOT WEATHER PLOUGHING.														RAIN PLOUGHING.													
		Variety of Wheat.	AREA.		ACTUAL OUT-TURN.				OUTTURN PER ACRE.				REMARKS.			Variety of wheat.	AREA.		ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		*Bhusa.*		*Grain.*		*Bhusa.*								*Grain.*		*Bhusa.*		*Grain.*		*Bhusa.*		
No. of square.	No. of plot.		Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		No. of square.	No. of plot.		Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
6	7	Type No. XI...	9	7	24	17	69	21	20	36	59	19	Ploughed on 7th June 1911.	6	8	Type No. XI	8	18	13	5	24	22	11	32	22	3	Ploughed on 2nd September 1911.
6	13	Pusa variety...	8	0	16	18	49	0	16	18	49	0	Ploughed on 23rd May 1911.	6	10	Ditto	8	0	18	36	33	31	18	36	33	31	Ploughed on 1st September 1911.
6	9	Type No. XI...	9	2	16	0	31	36	14	3	28	2	Ploughed on 22nd May 1911.	6	12	Ditto	8	18	19	5	46	1	17	7	41	14	Ploughed on 2nd September 1911.
6	11	Ditto ...	8	0	18	0	40	22	18	0	40	22	Ploughed on 23rd May 1911.	6	14	Ditto	9	11	18	19	34	0	15	19	28	19	Ploughed on 1st September 1911.
		Total ...	...	...	...	...	...	...	69	19			Ploughings ... 2 Harrowings ... 5 Weeding and hoeing ... 1 Waterings ... 4 Date of sowing 8th November 1911 and 9th November 1911. Date of harvesting 20th to 24th April 1912.														Rain on— June 15th ... ·71 June 17th ... 1·84 June 26th ... ·08 July 4th ... ·32 August 24th ... ·25 August 30th ... 1·22

STATEMENT No. XXI.

Statement showing the result of wheat types grown at the Lyallpur Agricultural Station, Rabi 1911-12.

NUMBER OF		AREA.		Number of type.	Previous crop.	DATE OF		OUTTURN OF GRAIN PER ACRE.		OUTTURN OF BHUSA PER ACRE.		REMARKS.
Square.	Plot.	Kanals.	Marlas.			Sowing.	Harvesting.	Maunds.	Seers.	Maunds.	Seers.	
26	$\frac{A}{1}$ 1	8	0	12	Wheat ...	6th Novemebr 1911...	23rd April 1912 ...	19	17	64	25	Germination good; tillering good; growth luxuriant; badly lodged, rust in traces.
	$\frac{A}{1}$ 2	8	0	14	Do. ...	6th November 1911...	25th April 1912 ...	19	2	70	21	Germination good; tillering good; growth fair and poorer on the northern sides; rust present; all lodged.
	$\frac{A}{1}$ 3	8	0	15	Do. ...	7th November 1911...	26th April 1912 ...	16	17	43	16	Germination good; tillered well; growth not very regular on account of poor soil on the northern side; rust present; ⅓rd lodged.
	$\frac{A}{2}$ 1	8	0	13	Senji	7th November 1911...	27th April 1912 ...	26	24	80	11	Germination good; tillering good; condition good; growth luxuriant; badly rusted; all lodged.
	$\frac{A}{2}$ 2	8	0	9	Do.	7th November 1911...	2nd May 1912 ...	23	34	71	2	Germination good; tillered very well,; growth regular; rust in traces; ⅓rd lodged.
	$\frac{A}{2}$ 3	8	0	11	Do.	7th November 1911...	29th April 1912 ...	26	31	68	31	Germination regular; tillering good; growth luxuriant; badly lodged; rust in traces.
												Ploughings ... ... 2 Harrowings ... ... 10 Chain harrow ... ... 1 Waterings ... ... 3 Weeding and hoeings ... 1

STATEMENT No. XXI (*a*).

Statement showing the outturn of wheat types at the Lyallpur Agricultural Station grown in square No. 2, rabi 1911-12.

Number of square.	Number of plot.	AREA.		Number of type.	Previous crop.	DATE OF		ACTUAL OUTTURN OF GRAIN.		ACTUAL OUTTURN OF BHUSA.		OUTTURN PER ACRE OF GRAIN.		OUTTURN PER ACRE OF BHUSA.		REMARKS.
		Kanals.	Marlas.			Sowing.	Harvesting.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	
2	6	8	18	8	*San* ploughed in 1910.	18th November 1911.	26th April 1912.	12	13	28	2	11	3	25	7	Germination good, tillering fair, erect, rust present.
	7	8	13	18	*San* for seed in 1910.	18th November 1911.	23rd April 1912.	14	8	26	7	13	5	24	8	Germination not very regular, tillering good, growth patchy on account of kallar, badly rusted.
	8	8	18	19	*San* ploughed in 1910-11.	18th November 1911.	25th April 1912.	15	32	34	31	14	8	31	10	Germination good but irregular, growth fair, rust present.
	9	9	2	20	*San* ploughed in 1910-11.	18th November 1911.	26th April 1912.	16	2	23	3	14	4	20	11	Germination good, tillering good ; growth fair but patchy, rust present.
	12	8	18	21		19th November 1911.	26th April 1912.	9	27	37	7	8	28	33	17	Germination fair, tillering good, growth patchy, rust in traces.
	13	9	2	22		19th November 1911.	25th April 1912.	8	9	20	34	7	18	18	13	Germination fair, growth irregular, tillering poor, erect, rust present.
	14	9	2	23		19th November 1911.	23rd April 1912.	8	20	18	11	7	19	16	3	Ditto.
	15	9	2	24		19th November 1911.	23rd April 1912.	11	25	27	0	20	9	23	29	Germination good, tillering fair, all standing, rust present.
	22	8	0	25		22nd November 1911.	27th April 1912.	13	3	26	35	13	3	26	35	Germination good, tillered well, growth fair but patchy, erect, rust present.
	23	8	0	15		22nd November 1911.	27th April 1912.	11	35	24	21	11	35	24	21	Germination good, tillering good, growth fair but patchy, rust present.
	24	8	0	12		22nd November 1911.	27th April 1912.	10	27	21	19	10	27	21	19	Germination fair, but irregular, growth fair, tillering good, rust in traces.
	25	8	9	12		22nd November 1911.	27th April 1912.	12	10	27	10	11	24	25	32	Ditto.

STATEMENT No. XXI (*l*).

Statement showing the outturn of wheat types at the Lyallpur Agricultural Station, grown with the tenants, in rabi 1911-12.

No. of		Area.		No. of type.	Previous crop.	Date of		Outturn of grain, per acre.			Type of soil.	Remarks.
Square.	Plot.	Kanals.	Marlas.			Sowing.	Harvesting.	Mds.	Seers.	Chs.		
1	21 22	9	16	11	Wheat ...	26th October 1911 ...	11th April 1912 ...	17	18	12	Medium loam ...	Germination good, tillered well, all erect, rust in traces, growth regular.
	24	8	9	10	Do. ...	17th November 1911 ...	28th April 1912 ...	14	1	6	Sandy loam ...	Germination good, tillering good, mostly erect, rust in traces.
3	1, 2, 3, 9, 12, 19, 20, 21, 22	64 ...	11 ...	11 ...	Wheat ... Water melon ...	25th October 1911 to 9th November 1911.	19th April 1912 to 28th April 1912.	12	30	13	Do. ...	Germination good, tillered well, erect rust in traces, growth mostly regular.
	8, 13, 18	25	14	9	Wheat ...	26th October 1911 ...	18th April 1912 ...	17	2	14	Medium loam ...	Germination good, mostly erect, tillered well, rust in traces, condition good.
5	1	7	10	Pusa 106	Do. ...	8th November 1911 ...	23rd April 1912 ...	21	30	6	Do. ...	Germination regular, condition well, tillering good, rust present, half lodged.
	10, 11	17	16	9	Fallow Senji ...	7th November 1911 ...	25th April 1912 to 26th April 1912.	19	5	13	Heavy loam ...	Germination good, tillered well, rust present, all lodged, condition good.
6	4, 6, 15 16 20	40	8	9	Senji, fallow wheat.	26th October 1911 to 28th October 1911.	23rd April 1912 to 28th April 1912.	19	36	13	Do. ...	Germination good, tillered well, all lodged, growth regular, badly rusted.

	7 to 12 and 14	61	16	11	Do. ...	8th November 1911 to 9th November 1911.	20th April 1912 to 29th April 1912.	16	23	...	Calcarious loam with patches of kallar.	Germination good, tillering fair, growth fair but patchy, rust in traces, mostly erect.
	13	2	...	Muzaffarnagar White Pusa.	Do. ...	14th November 1911 ...	22nd April 1912 ...	16	...	...	Calcarious loam	Germination good, tillered well, badly lodged, rust bad in 1, 2 and 4 and in traces in 3.
	13	2	...	Pusa No. 8	Do. ...	14th November 1911 ...	22nd April 1912 ...	17	24	...	Do.	
	13	2	...	Pusa No. 12	Do. ...	14th November 1911 ...	22nd April 1912 ...	18	32	...	Do.	
	13	2	...	Pusa No. 22	Do. ...	14th November 1911 ...	22nd April 1912 ...	13	16	...	Do.	
7	15 and 16	17	6	25	Melons ...	27th October 1911 ...	11th April 1912 ...	20	...	14	Medium loam ...	Germination good, tillered very well, all standing, rust present, early maturing, condition good.
8	7	9	7	13	Fallow ...	26th October 1911 ...	20th April 1912 ..	18	26	1	Sandy loam ...	Germination good, tillered well, ¼th lodged, rust present.
	8	9	11	14	Wheat ...	23th October 1911 ...	21st April 1912 ...	18	15	11	Do. ...	Germination good, tillering fair, all erect, rust in traces.
	11, 12 to 15	39	5	11	Chari, wheat, Senji	9th November 1911 to 14th November 1911.	27th April 1912 ...	13	26	3	Do. ...	Germination good, tillering fair, growth patchy, all standing, rust in traces, condition on the whole fair.
9	14, 15	16	18	15	Fallow, Moth and Guara.	7th November 1911 to 8th November 1911.	28th April 1912 ...	13	32	6	Medium loam with patches of kallar.	Germination good, tillered well, all erect, rust present.
10	1, 2	14	8	17	Cotton ...	8th November 1911 ...	14th April 1912 ...	17	16	4	Medium loam ...	Germination good, tillering good, all standing, growth regular, rust in traces.

STATEMENT No. XXI (c).

Showing the outturn of wheat types grown with the tenants at the Lyallpur Agricultural Station in Rabi 1911-12.

NUMBER OF		AREA.		No. of type.	Previous crop.	DATE OF		OUTTURN OF GRAIN PER ACRE.			Type of soil.	REMARKS.
Square.	Plot.	Kanals.	Marlas			Sowing.	Harvesting.	Maunds.	Seers.	Chattaks.		
12	3, 4, 5, 17, 18	41	5	11	Wheat ...	4th November 1911 to 23rd November 1911	21st April 1912 to 29th April 1912	13	8	0	Calcarious loam	Germination regular; condition fair on the whole; all standing; tillered well; rust present.
...	8	8	18	16	Do. ...	24th November 1911 ...	21st April 1912 ...	14	36	13	Do. ...	Germination good; tillered well: condition good; one-eighth lodged; badly rusted.
13	8, 9, 10	27	10	9	Do. ...	8th November 1911 ...	23rd April 1912 to 29th April 1912	20	15	6	Heavy loam ...	Germination good; growth luxuriant; tillered very well; rust present; one-sixth lodged; slight shrivelling in grain.
...	6	9	2	9 A 2	Do. ...	13th November 1911 ...	25th April 1912 ...	17	10	15	Do. ...	Germination good: tillering good; badly rusted; all lodged; condition good.
...	7	9	2	9 E 1	Do. ...	9th November 1911 ...	16th April 1912 ...	19	31	3	Do. ...	Germination good; tillered well; rust present, all lodged; condition good.
16	7, 9	17	16	9	Do. ...	10th November 1911 ...	19th April 1912 ...	19	20	3	Do. ...	Germination good; tillered well; two-thirds lodged; condition good; rust in trace.

...	8	9	2	9 E 3	Do. ...	8th November 1911 ...	21st April 1912 ...	16	10	8	Do. ...	Germination good; tillered well; condition good; all lodged; badly rusted.
...	14	9	2	9 E 10	Do. ...	13th November 1911 ...	22nd April 1912 ...	15	33	13	Do. ...	Germination good; tillered well; all lodged; condition good; badly rusted.
...	18	8	18	9 E 9	Do. ...	7th November 1911 ...	20th April 1912 ...	16	23	5	Do. ..	Germination good; tillered well; all lodged; condition good; intensely rusted.
...	17	9	2	9 E 13	Do. ...	9th November 1911 ...	23rd April 1912 ...	17	30	5	Do. ...	Germination good; tillering good; all lodged; badly rusted; condition good.
17	9, 10	7	13	1	Do. ...	18th November 1911 ...	24th April 1912 ...	3	33	1	Medium loam ...	Germination thin; tillering fair; condition poor; rust present all standing; attacked badly by sparrows; late maturing.
...	12	8	18	Pusa No. 1	Do. ...	18th November 1911 ...	25th April 1912 ...	14	33	4	Heavy loam ...	Germination good; tillered very well; condition good; all standing; rust present; grain shrivelled to some extent.
18	13, 17, 19	22	...	11	Do. ...	19th November 1911 to 30th November 1911	20th April 1912 to 25th April 1912	11	33	7	Medium loam ...	Germination good; tillered well; one-fifth lodged; rust present.
...	21	...	...	...	Senji, wheat ...							
17	18, 23, 24	26	18	9	Do. ...	4th November 1911 to 20th November 1911	25th April 1912 to 30th April 1912	15	21	8	Do. ...	Germination good; condition good; tillered very well; badly rusted; one-ninth lodged; grain shrivelled to some extent.

Statement No. XXII

Showing the result of green manuring experiments at the Lyalpur Agricultural Station,—Kharif and Rabi 1911-12.

No. of square.	No. of plot.	Area.		Type of wheat grown in 1910-11 when no manure was applied.	Outturn per acre of wheat in 1910-11.			Type of wheat grown in 1911-12 after green manuring with san.	Yield per acre of wheat in 1911-12.			Increase of grain per acre.			Remarks.
		Kanals.	Marlas.		Mds.	Srs.	Chks.		Mds.	Srs.	Chks.	Mds.	Srs.	Chks.	
8	2, 9, 12 and 19.	37	15	IX	9	1	0	XI	13	18	4	4	17	4	
11	1	7	4	Desi Lall ...	10	17	0	XI	17	2	4	6	25	4	

STATEMENT No. XXIII

Cattle feeding experiments at the Lyallpur Agricultural Station in 1911-12,—*Gram* versus *Gram and Maize mixed.*

Date of weighing.	Particulars of grain.	BULLOCK No. 1. Weight.			BULLOCK No. 2. Weight.			REMARKS.	Date of weighing.	Particulars of grain.	BULLOCK No. 1. Weight.			BULLOCK No. 2. Weight.			REMARKS.
		Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.				Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	
13th February 1912.	Gram alone at 2 seers per head per day.	8	3	11	8	2	5		13th February 1912.	Gram and maize mixed, at 2 seers per day per head.	7	2	6	8	2	3	
20th February 1912.		9	1	2	8	3	11		20th February 1912.		7	2	4	8	2	9	
2nd March 1912.		9	0	0	8	2	4		2nd March 1912.		7	3	2	8	2	13	
Total ...		+0	0	17	0	0	1		Increase ...		+0	0	+24	0	0	10	

STATEMENT No. XXIV.

Cattle-feeding experiments at the Lyallpur Agricultural Station in 1911-12 (*bhusa* plus *green senji* versus *bhusa* plus *ensilage*).

Date of weighing.	Particulars of food.	Bullock No. 1.			Bullock No. 2.			Remarks.	Date of weighing.	Particulars of food.	Bullock No. 1.			Bullock No. 2.			Remarks.
		Weight.			Weight.						Weight.			Weight.			
		Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.				Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	
16th February 1912.	Bhusa *plus* green senji.	7	2	0	7	1	24		16th February 1912.	Bhusa *plus* ensilage.	9	1	14	8	0	9	
23rd February 1912.		8	1	0	7	3	24		23rd February 1912.		9	2	26	8	2	9	
2nd March 1912.		7	3	10	7	2	14		2nd March 1912.		9	0	21	8	1	0	
14th March 1912.		8	0	9	7	0	13		14th March 1912.		9	1	10	8	2	11	
		+0	2	9	−0	1	11				−0	0	4	+	2	2	

Feeding of two pairs of cattle fed on bhusa and ensilage versus *bhusa and senji.*

Date of weighment.	Weight of pair of bullocks fed on ensilage and bhusa.						Weight of pair of bullocks fed on senji and bhusa.						Remarks.
	1			2			1			2			
	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	
16th February 1912...	8	0	9	9	1	14	7	1	24	7	2	0	
23rd February 1912...	8	2	9	9	2	26	7	3	24	8	1	0	
2nd March 1912 ...	8	1	0	9	0	21	7	2	14	7	3	10	
14th March 1912 ...	8	2	11	9	1	10	7	0	13	8	0	9	

STATEMENT NO. XXV.

Showing the yield of Economic Botanist's cotton grown on large areas with tenants at the Lyallpur Agricultural Station in Kharif 1911.

No. of		Variety.	Area.		Total outturn.			Outturn per acre.			Remarks.
Square.	Killa.		Kanals.	Marlas.	Maunds.	Seers.	Chattaks.	Maunds.	Seers.	Chattaks.	
6	3	Type No. 2, Desi	8	18	2	27	15	2	16	6	
17	25	Farm selected, broad leaf.	8	5	3	34	15$\frac{3}{4}\frac{1}{4}$	3	30	5	
7	12, 19	Type No. 4 F ...	13	13	11	39	11	6	37	7	
9	17, 18	Ditto ...	17	16	16	25	9	7	19	2	
7	2, 3	Ditto ...	17	16	7	16	3$\frac{1}{3}$	3	12	0	
1	16, 25	Ditto ...	16	0	6	28	1$\frac{1}{6}$	3	14	0	
6	17, 18	Type No. 3 F ...	18	13	19	31	14	8	19	11	
12	24	Ditto ...	9	2	12	12	10$\frac{7}{132}$	11	1	5	
13	19, 22	Ditto ...	18	0	18	33	12	8	15	0	
16	6, 15	Ditto ...	14	19	13	29	10$\frac{1}{2}$	7	14	2	
17	22	No. 161 F ...	9	2	3	28	3	3	10	3	
16	21	No. 126 F ...	9	11	7	15	11$\frac{1}{2}$	6	7	11	

STATEMENT NO. XXVI-A.

Showing cultural and other details of Imperial Economic Botanist's Wheat grown at the Lyallpur Agricultural Station in Rabi 1911-12.

Variety of wheat.	Type of soil.	Previous crop.	Manuring.	Preparation of the land for the wheat crop.	Date and method of sowing.	Seed rate.	Rainfall.				Irrigation.	Date of harvesting	Yield per acre.				Remarks.
							Sowing time (April to October).		Growth period (November to March).				Grain.		Bhusa.		
							Date.	Rain-fall in inches.	Date.	Rain-fall in inches.			Mds.	Srs.	Mds.	Srs.	
Muzaffargarh Pusa ...	Calcarious loam.	Wheat	No manure.	1. Ploughings with Raja plough ... 2 2. Harrowings with spring T. harrow... 5 3. Weeding and hoeing 1	On 14th November 1911; sown behind the plough.	28 seers per acre.	23rd April 1911 2nd May 1911...	·71 ·05	11th November 1911.	·25	Four waterings.	22nd April 1912	16	0	40	12	
Pusa No. 8	Do.	Do.		Ditto	Ditto	Do.	5th May 1911... 15th June 1911	·11 ·71	20th January 1912.	·66		22nd April 1912	17	24	49	28	
Pusa No. 12... ...	Do.	Do.		Ditto	Ditto	Do.	17th June 1911 26th June 1911	1·84 ·08	21st January 1912.	·97		22nd April 1912	18	32	54	12	
Pusa No. 22... ...	Do.	Do.		Ditto	Ditto	Do.	4th July 1911 ..	·32	...	...		22nd April 1912	13	16	51	36	
9 E 1	Light sandy loam.	Do.		1. Ploughings with Raja plough ... 2 2. Harrowings with S. T. harrow ... 4 3. Chari harrow ... 1 4. Hoeing with hand hoe... ... 1	On 30th October 1911, and sown behind the plough.	Do.	24th August 1911 30th August 1911	·25 1·22	...	...	Three waterings.	23rd April 1912	20	4	74	28	
9 E 2	Do.	Do.			Ditto	Do.	21st September 1911.	·25	...	...		23rd April 1912	21	28	64	16	The duplicates of these were grown on larger areas in squares 5, 13 and 16.
9 E 3	Do.	Do.		Ditto	Ditto	Do. ...	...	...	...	...		23rd April 1912	19	4	77	8	
9 E 9	Do.	Do.		Ditto	Ditto	Do. ...	...	...	...	...		23rd April 1912	13	8	51	8	
9 E 10	Do.	Do.		Ditto	Ditto	Do. ...	...	...	...	...		24th April 1912	9	32	37	24	
9 E 13	Do.	Do.		Ditto	Ditto	Do. ...	...	...	...	...		24th April 1912	13	20	42	16	
Pusa No. 106 ...	Do.	Do.		Ditto	Ditto	Do. ...	...	...	...	...		24th April 1912	16	4	46	16	

STATEMENT No. XXVI-B.

Statement showing cultural and other details of Imperial Economic Botanist's wheats grown on large areas with the tenants at the Lyallpur Agricultural Station in rabi 1911-12.

NUMBER OF		Variety of wheat.	Type of soil.	Previous crop.	Manuring.	Preparation of land for wheat crop.	Date and method of sowing.	Seed rate.	RAINFALL.				Irrigation.	Date of harvesting.	YIELD PER ACRE.		REMARKS.
									(*Sowing time*) *April to October.*		(*Growth period*) *November to March.*						
Square.	Plot.								Date.	Rainfall in inches.	Date.	Rainfall in inches.			Maunds.	Seers.	
13	6	9 A. 2	Heavy loam.	Wheat	No manure.	Ploughing with Raja plough. 1 Harrowings ... 5 Hoeing ... 1	13th November 1911. Sown behind the plough.	From 24 seers to 26 seers.	23rd April 1911 2nd May 1911	·71 ·05	11th November 1911. 20th January 1912.	·25 ·66	Two irrigations.	25th April 1912	17	11	
13	7	9 E. 1	Do.	Do.	Do.	Ploughing with Raja plough. 1 Harrowings ... 5 Hoeing ... 1	9th November 1911.		5th May 1911 15th June 1911	·11 ·71	21st January 1912.	·97		16th April 1912	19	31	
16	8	9 E. 3	Do.	Do.	Do.	Ploughing with Raja plough. 2 Harrowings ... 6 Hoeing ... 1	8th November 1911.		17th June 1911 26th June 1911	1·84 ·08	...	...		21st April 1912	16	11	
16	14	9 E. 10	Do.	Do.	Do.	Ploughing with Raja plough. 1 Harrowings ... 4 Weeding and hoeing 1	13th November 1911.		4th July 1911 ...	·32	...	...		22nd April 1912	15	34	
16	18	9 E. 9	Do.	Do.	Do.	Ditto ...	7th November 1911.		24th August 1911 30th August 1911	·25 1·22	...	...		20th April 1912	16	23	
16	17	9 E. 13	Do.	Do.	Do.	Ditto ...	9th November 1911.		21st September 1911.	·25	...	...		23rd April 1912	17	30	
5	1	Pusa 106	Do.	Do.	Do.	Ditto ...	8th November 1911.		...	...	...	...		Ditto	21	30	
									Total	5·54		1·88					

Statement A.

Punjab Classified Wheats.

Type No.	Particulars of variety.				Date of			Outturn per acre in 1912.				Condition of the standing crop in 1912.						Total area, in acres.	Estimated damage done by frost in 1912.		Remarks.
								Grain.		Straw.		Good.		Medium.		Poor.					
	Botanical name.	Local name or place of origin.	Bearded or beardless.	Colour of grains.	Sowing.	Earing.	Ripening.	Maunds.	Seers.	Maunds.	Seers.	Area in acres.	Height in feet.	Area in acres.	Height in feet.	Area in acres.	Height in feet		Maunds.	Seers.	
IX	Triticum vulgare.	Lal Kale Kasarwali (standard).	Bearded...	Red ...	7th November 1911.	5th March 1912	23rd April 1912	30	16	79	8	$\frac{1}{32}$	4½	...	...	...	...	$\frac{1}{32}$	...	...	Germination thin; tillering fair; trace of rust.
I	Triticum durum	Wadanak of Zira, Sialkot, Batala, Montgomery, Amritsar; Dagar of Dera Ghazi Khan, Shahpur, Ferozepore, Muzaffargarh, Multan, Lyallpur; Palestine of Lahore.	Do. ...	Amber	8th November 1911.	4th March 1912	Ditto	22	20	61	20	$\frac{1}{12}$	5	...	...	...	...	$\frac{1}{12}$	...	...	Germination regularly thin; tillering very poor, trace of rust.
IX	Triticum vulgare.	Lal Kale Kasarwali (standard).	Do. ...	Red ...	Ditto	Ditto	Ditto	26	32	70	..	...	...	$\frac{1}{32}$	4	...	...	$\frac{1}{32}$	...	...	Germination regularly thin; tillering fair; trace of rust; border.
II	Triticum durum	Stray in Wadanak, Kalchangari of Montgomery.	Do. ...	Do. ...	Ditto	5th March 1912	24th April 1912	20	16	60	24	$\frac{1}{24}$	5¼	$\frac{1}{24}$	5	...	...	$\frac{1}{12}$	...	...	Germination regularly thin; tillering very poor; trace of rust.
III	Ditto ...	Stray in Wadanak of Lyallpur.	Do. ...	Amber	Ditto	6th March 1912	23rd April 1912	20	28	55	20	...	...	$\frac{1}{12}$	4½	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering poor, but better than types Nos. I and II; trace of rust. This was the latest Wadanak to ripen.
IV	Triticum compectum.	Makki of Chiniot ...	Half-bearded.	Red ...	Ditto	24th February 1912.	16th April 1912	27	24	63	...	$\frac{1}{12}$	3¼	...	...	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering poor; slight rust.
V	Ditto ...	Found in Makkawali of Dera Ghazi Khan.	Beardless	White	Ditto	27th February 1912.	18th April 1912	24	...	64	8	$\frac{1}{12}$	3¼	...	...	...	...	$\frac{1}{12}$	...	...	Germination thin; tillering fair; rust bad.

VI	Ditto	Stray in Makkini of Multan.	Do. ...	Red ...	Ditto	26th February 1912.	17th April 1912.	23	16	65	28	1/12	3½	...	...	...	...	1/12	...	...	Germination regular; tillering fairly good; rust very bad.
VII	Ditto	Common dwarf wheat; Rodhi of Shahpur; Rangrih or Ghiali of Kangra; Makhini of Multan; Daudi of Muzaffargarh; Daudan of Multan; Makkawali of Dera Ghazi Khan; and Daudi of Multan.	Do. ...	White	Ditto	28th February 1912.	Ditto	23	10	64	26	1/12	3½	...	...	...	...	1/12	...	...	Germination thin; tillering poor; worst rusted of all the 25 types.
IX	Triticum vulgare.	Lal Kale Kasarwali (standard).	Bearded...	Red ...	Ditto	5th March 1912.	23rd April 1912.	32	...	91	8	1/32	5	...	...	...	...	1/32	...	...	Germination regularly; thin; tillering fair trace of rust.
VIII	Ditto	Stray in Lal Kasarwali of Lyallpur.	Do. ...	Do. ...	Ditto	7th March 1912.	21st April 1912.	28	8	76	8	1/12	4½	...	...	...	...	1/12	...	...	Germination regular; tillering poor; trace of rust.
X	Ditto	Found in Sufed of Moga; No. 4 Punjab old; Mundi of Ludhiana; Jogi of Karnal.	Do. ...	Amber	Ditto	2nd March 1912.	17th April 1912.	26	22	68	22	1/12	4	...	...	...	...	1/12	...	...	Germination regular; tillering poor; rust bad.
XI	Ditto	Found in Sufed of Amritsar; Sohon of Chiniot; Kunjhari of Dera Ghazi Khan; Daudi of Lyallpur; and Jogi of Karnal.	Do. ...	Do. ...	Ditto	26th February 1912.	18th April 1912.	29	28	74	4	1/12	4¼	...	...	...	...	1/12	...	...	Germination regular; tillering poor; trace of rust.
XII	Ditto	Found in Rangrih of Palampur.	Do. ...	Do. ...	Ditto	1st March 1912.	20th April 1912.	26	4	78	12	1/12	4¼	...	...	...	...	1/12	...	...	Germination regular; tillering fair; trace of rust.
XIII	Ditto	Found in Lal Kale Kasarwali of Lyallpur.	Do. ...	Red ...	Ditto	7th March 1912.	22nd April 1912.	27	36	90	...	1/12	4½	...	...	...	...	1/12	...	...	Germination regular; tillering good; trace of rust.
XIV	Ditto	Found in Lal of Karnal, Sialkot, Attock; Lal Safed of Sirsa; Lal of Zira; Kasalu or Surkh of Ferozepore; Ratti or Lal of Pind Dadan Khan; Lal of Ludhiana; Desi Surkh of Jullundur; Lal Desi of Jhelum; Lal of Delhi and Rawalpindi; and Kunjhari of Muzaffargarh.	Do. ...	Do. ...	Ditto	3rd March 1912.	18th April 1912.	26	28	81	24	1/12	4	...	...	...	...	1/12	...	...	Germination regular; tillering fair; trace of rust.

STATEMENT A—*concluded.*

Type No.	Particulars of variety.				Date of			Outturn per acre in 1912.				Condition of the standing crop in 1912,						Total area, in acres.	Estimated damage done by frost in 1912,		Remarks.
								Grain.		*Straw.*		*Good.*		*Medium*		*Poor.*					
	Botanical name.	Local name or place of origin.	Bearded or beardless.	Colour of grains.	Sowing.	Earing.	Ripening.	Maunds.	Seers.	Maunds.	Seers.	Area in acres.	Height in feet.	Area in acres.	Height in feet.	Area in acres.	Height in feet.		Maunds.	Seers.	
IX	Triticum vulgare.	Lal Kale Kasarwali (standard).	Bearded...	Red ...	8th November 1911.	6th March 1912.	23rd April 1912.	27	16	85	16	$\frac{1}{32}$	4½	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
XV	Ditto	Found in Ratti or Lal of Pind Dadan Khan; Watni of Shahpur; and Kunjhari of Multan.	Do. ...	Do. ...	Ditto	4th March 1912.	20th April 1912.	24	...	79	8	$\frac{1}{24}$	4½	$\frac{1}{24}$	3¼	...	...	$\frac{1}{12}$	...	...	Ditto ditto.
XVI	Ditto	Found in Ghoni of Lahore; Sufed of Ludhiana, Rohtak and Batala; Daudkhani of Dasuha and Delhi; Rori of Montgomery; Sufed Kasarwali of Lyallpur.	Do. ...	White	Ditto	2nd March 1912.	18th April 1912.	23	16	76	20	$\frac{1}{24}$	3¾	$\frac{1}{24}$	3¾	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering fair; slightly rusted.
XVII	Ditto	Common Rodi of Attock; Ghoni of Gujrat, Sialkot, Jhelum, Chiniot, Amritsar, Batala; Mundi of Karnal and Ludhaina; Sufed of Lahore; Kauku of Palampur; Jhakrih of Palampur; Sufed Brijsonda of Rohtak; Ratti of Muzaffargarh; Desi of Dera Ghazi Khan; and Suthri of Multan; very common wheat.	Beardless	Amber	Ditto	28th February 1912.	19th April 1912.	27	24	78	...	$\frac{1}{12}$	3¼	...	...	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering fairly good; trace of rust.

XVIII	Ditto	Found in Rodi of Muzaffargarh; Ratti of Muzaffargarh; Desi of Dera Ghazi Khan; Suthri of Multan; Ghoni of Chiniot and Amritsar; Jhakrih of Palampur.	Do. ...	Do. ...	Ditto	3rd March 1912.	22nd April 1912.	27	...	82	20	$\frac{1}{12}$	4	...	...	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering good; trace of rust.
XIX	Ditto	Stray in Buggi of Leiah	Do. ...	White	Ditto	3rd March 1912.	20th April 1912.	25	14	79	14	$\frac{1}{18}$	$4\frac{1}{2}$	$\frac{1}{36}$	4	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering good; rust bad.
XX	Ditto	Found in Ghoni of Amritsar.	Do. ...	Amber	Ditto	2nd March 1912.	22nd April 1912.	25	8	80	4	$\frac{1}{24}$	$3\frac{3}{4}$	$\frac{1}{24}$	$3\frac{1}{2}$	...	...	$\frac{1}{12}$	...	...	Germination regularly thin; tillering good; rust bad.
IX	Ditto	Lal Kale Kasarwali (standard).	Bearded...	Red ...	Ditto	5th March 1912.	23rd April 1912.	30	16	91	8	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
XXI	Ditto	Found in Kanku of Palampur; Rodi of Attock; Ghoni of Gujrat and Sialkot; Khoni of Jhelum and Batala; and Jhakrih of Mundi of Karnal, Jullundur and Ludhiana; Ratti or Kunjhari of Muzaffargarh; Kunjhari of Multan.	Beardless	Amber...	Ditto	28th February 1912.	17th April 1912.	25	8	75	12	$\frac{1}{24}$	4	$\frac{1}{24}$	$3\frac{3}{4}$	...	...	$\frac{1}{12}$	...	...	Germination thin; tillering good; trace of rust.
XXII	Ditto	Found in Ghoni of Sialkot.	Do. ...	Red ...	Ditto	29th February 1912.	20th April 1912.	27	...	80	4	$\frac{1}{12}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering fair; trace of rust.
XXIII	Ditto	Found only in Ratti of Muzaffargarh.	Do. ...	Do. ...	Ditto	2nd March 1912.	22nd April 1912.	26	4	84	24	$\frac{1}{12}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{12}$	...	...	Germination regularly thin; tillering fair; rust bad.
XXIV	Ditto	Found in Ghoni of Chakwal; Kunjhari of Muzaffargarh; and Baggi of Leiah.	Do. ...	White		3rd March 1912.	Ditto	23	16	80	4	$\frac{1}{24}$	$4\frac{1}{4}$	$\frac{1}{24}$	4	...	...	$\frac{1}{12}$	...	...	Germination regularly thin; tillering good: rust bad.
XXV	Ditto	Found in Baggi of Leiah	Do. ...	Do. ...	Ditto	28th February 1912.	20th April 1912.	24	30	75	6	$\frac{1}{24}$	4	$\frac{1}{24}$	$3\frac{3}{4}$	...	...	$\frac{1}{12}$	...	...	Germination regularly thin; tillering good; trace of rust.
IX	Ditto	Lal Kale Kasarwali (standard).	Bearded...	Red ...	Ditto	6th March 1912.	24th April 1912.	27	36	94	38	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; rust bad; border.

N.B.—All the above wheats lodged just after irrigation on 30th March 1912. The grains had developed to a considerable extent by then, however, therefore the outturns were probably little affected.

STATEMENT B.

Indigenous Wheat.

Variety.	Date of			Outturn per acre in 1912.				Outturn per acre in 1911.		Outturn per acre in 1910.		Condition of the standing crop in 1912.						Total area in acres.	Estimated damage done by frost.		Remarks.
				Grains.		*Straw.*		*Grains.*		*Grains.*		*Good.*		*Medium.*		*Poor.*					
	Sowing.	Earing.	Ripening.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Area in acres.	Height in feet.	Area in acre.	Height in feet.	Area in acre.	Height in feet.		Maunds.	Seers.	
1.—COMMON WHEATS, BEARDLESS WHEATS WITH RED GLUMES AND WHITE GRAINS.																					
(Standard) Type No. IX.	7th November 1911.	5th March 1912.	23rd April 1912.	23	8	71	8	...	...	...	...	...	...	$\frac{1}{32}$	5	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
Stray No. 4 ...	Ditto.	28th February 1912.	21st April 1912.	24	4	77	36	19	13	25	24	...	...	$\frac{1}{4}$	$4\frac{1}{2}$	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fair; trace of rust. Punjab type No. XVIII, hence rejected.
" " 6 ...	Ditto.	27th February 1912.	19th April 1912.	20	24	64	8	19	13	25	...	...	...	$\frac{1}{4}$	4	...	...	$\frac{1}{4}$	...	...	Germination thin; tillering fair; trace of rust; new type.
(Standard) Type No. IX.	Ditto.	4th March 1912.	23rd April 1912.	27	8	89	24	...	...	...	...	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination thick; tillering fair.
Stray No. 38 ...	Ditto.	26th February 1912.	18th April 1912.	18	30	54	26	16	8	17	4	...	...	$\frac{1}{4}$	$4\frac{1}{4}$	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fair; rust bad; new type.
" " 49 ...	Ditto.	5th March 1912.	24th April 1912.	20	4	69	8	18	3	28	32	...	...	$\frac{1}{4}$	$4\frac{1}{2}$	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering poor; rust bad; Punjab type No. XX, hence rejected.
(Standard) Type No. IX.	Ditto.	4th March 1912.	23rd April 1912.	29	24	85	24	...	...	...	...	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination thick; tillering fair; trace of rust.
Stray No. 51 ...	Ditto.	5th March 1912.	29th April 1912.	19	18	70	14	13	11	22	16	...	...	$\frac{1}{4}$	$4\frac{1}{2}$	...	...	$\frac{1}{4}$	...	...	Germination regularly thin; tillering good; rust bad; late in ripening; new type.

Stray No. 56 ...	Ditto	2nd March 1912.	22nd April 1912.	23	16	53	20	16	8	24	32	...	...	$\frac{1}{4}$	4	...	...	$\frac{1}{4}$	...	...	Germination regularly thin; tillering fair; slight rust; new type.
(Standard) type No. IX	Ditto	4th March 1912.	23rd April 1912.	28	32	77	24	...	...	...	...	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination thick; tillering fair; trace of rust.
Stray No. 67 ...	Ditto	26th February 1912.	18th April 1912.	26	8	59	24	26	6	25	24	$\frac{1}{4}$	$3\frac{3}{4}$	...	...	...	...	$\frac{1}{4}$	...	...	Germination regularly thin; tillering fair; trace of rust; Punjab type No. XVII, hence rejected.
" " 68 ...	Ditto	27th February 1912.	21st April 1912.	23	6	58	10	22	2	20	32	$\frac{1}{6}$	$4\frac{1}{2}$	$\frac{1}{12}$	4	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fair; trace of rust; Punjab type No. XVIII, hence rejected.
(Standard) type No. IX	Ditto	4th March 1912.	23rd April 1912.	18	22	53	22	...	...	...	...	...	...	...	...	$\frac{1}{7}$	4	$\frac{1}{7}$	...	...	Germination regularly thin; tillering fair; trace of rust; border.
(Standard) type No. IX	Ditto	5th March 1912.	22nd April 1912.	30	32	100	16	...	...	...	...	$\frac{1}{32}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust; border.
Stray No. 88 ...	Ditto	27th February 1912.	20th April 1912.	28	8	69	8	20	28	28	32	$\frac{1}{4}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fair; trace of rust: Punjab types Nos. XXV and XXIV, hence rejected.
2. BEARDLESS WHEATS WITH WHITE GLUMES AND WHITE GRAINS.																					
Stray No. 78 ...	7th November 1911.	27th February 1912.	21st April 1912.	23	28	80	24	22	10	24	16	$\frac{1}{8}$	$4\frac{1}{2}$	$\frac{1}{8}$	4	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fair; trace of rust; Punjab type No. XXV, hence rejected.
(Standard) type No. IX	Ditto	5th March 1912.	24th April 1912.	31	8	57	24	...	...	...	...	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
Stray No. 80 ...	Ditto	27th February 1912.	21st April 1912.	25	2	71	22	18	30	30	16	$\frac{1}{4}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering good; trace of rust; Punjab type No. XXV, hence rejected.
Stray No. 102 ...	Ditto	1st March 1912.	22nd April 1912.	20	4	81	...	24	...	26	16	$\frac{1}{4}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fairly good; slight effect of rust; Punjab types Nos. XXIV and XXV, hence rejected.
(Standard) type No. IX	Ditto	5th March 1912.	23rd April 1912.	32	...	96	32	...	...	...	...	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
Stray No. 105 ...	Ditto	26th February 1912.	21st April 1912.	23	14	70	14	17	15	27	24	$\frac{3}{20}$	$4\frac{1}{2}$	$\frac{1}{10}$	4	...	...	$\frac{1}{4}$	...	...	Germination regular; tillering fair; trace of rust; Punjab types Nos. XXIV and XXV, hence rejected.
Pusa No. 1 ...	Ditto	5th March 1912.	23rd April 1912.	26	12	75	12	...	...	...	...	$\frac{1}{4}$	4	...	...	...	...	$\frac{1}{4}$	...	...	Germination regularly thin; tillering good; slight attack of rust; stands well.
(Standard) type No. IX	Ditto	4th March 1912.	Ditto	31	8	82	16	...	...	...	...	$\frac{1}{32}$	$3\frac{3}{4}$	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.

N. B.—All the above wheats lodged just after irrigation on 30th March 1912 except Pusa No. 1.

The grains had developed to a considerable extent by then, however therefore the outturns were probably little affected.

Statement C.

Australian wheats.

1912.

Variety.	Date of			Outturn per acre in 1912.				Outturn per acre in 1911.		Outturn per acre in 1910.		Condition of the standing crop in 1912.						Total area in acres.	Estimated damage done by frost.		Remarks.
				Grains.		*Straw.*		*Grains.*		*Grains.*		*Good.*		*Medium.*		*Poor.*					
	Sowing.	Earing.	Ripening.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Area in acres.	Height in feet.	Area in acres.	Height in feet.	Area in acres.	Height in feet.		Maunds.	Seers.	
(Standard) Type No. IX	7th November 1911.	4th March 1912.	23rd April 1912.	31	8	82	16	...	...	...	...	$\frac{1}{32}$	$4\frac{3}{4}$	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
Caneback ...	Ditto ...	27th February 1912.	26th April 1912.	22	16	76	16	17	15	18	16	$\frac{1}{16}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{16}$	...	...	Germination thick; tillering fair; trace of rust.
Hudson's Early ...	Ditto ...	12th March 1912.	22nd April 1912.	26	12	80	20	13	19	21	24	$\frac{1}{16}$	5	...	...	...	...	$\frac{1}{16}$	...	...	Germination regularly thick; tillering fair; trace of rust.
John Brown ...	Ditto ...	8th March 1912	26th April 1912.	24	...	86	32	19	21	22	16	$\frac{1}{16}$	5	...	...	...	...	$\frac{1}{16}$	...	...	Germination regularly thick; tillering poor; trace of rust.
Ghuya's Early ...	Ditto ...	4th March 1912	22nd April 1912.	26	32	68	32	20	23	19	8	$\frac{1}{16}$	5	...	...	...	...	$\frac{1}{16}$	...	...	Germination regular; tillering good; trace of rust.
Bancraft ...	Ditto ...	7th March 1912	24th April 1912.	18	24	73	0	14	10	22	32	...	...	$\frac{1}{16}$	$4\frac{1}{2}$	...	...	$\frac{1}{16}$	...	...	Germination regular; tillering poor; trace of rust.
Sunset ...	Ditto ...	4th February 1912.	8th April 1912	20	...	66	0	18	30	15	16	...	...	$\frac{1}{16}$	4	...	...	$\frac{1}{16}$	...	...	Germination regularly thick; tillering poor; rust bad.
Medesh ...	Ditto ...	10th March 1912.	28th April 1912.	13	24	60	0	7	32	19	16	...	...	$\frac{1}{16}$	$5\frac{1}{2}$	...	...	$\frac{1}{16}$	...	...	Germination thin; tillering good; late in ripening and was damaged by birds.
(Standard) Type No. IX.	Ditto ...	5th March 1912.	23rd April 1912.	30	16	79	8	...	...	...	...	$\frac{1}{32}$	$4\frac{1}{2}$	...	–	...	...	$\frac{1}{32}$	...	...	Germination thin; tillering fairly good; trace of rust; border.

STATEMENT No. D.

Pothankot wheats.

VARIETY.	DATE OF			OUTTURN PER ACRE IN 1912.				CONDITION OF THE STANDING CROP IN 1912.						Total area in acres.	ESTIMATED DAMAGE DONE BY FROST.		REMARKS.
	Sowing.	Earing.	Ripening.	*Grains.*		*Straw.*		*Good.*		*Medium.*		*Poor.*					
				Mds.	Srs.	Mds.	Srs.	Area in acres.	Height in feet.	Area in acres.	Height in feet.	Area in acres.	Height in feet.		Mds.	Srs.	
(Standard) Type, No. IX...	21st November 1911 ...	7th March 1912 ...	23rd April 1912 ...	27	3	120	0	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; trace of rust.
Type No. XVII ...	Ditto ...	5th March 1912 ...	19th April 1912 ...	31	20	92	16	$\frac{1}{12}$	$4\frac{3}{4}$	...	...	...	...	$\frac{1}{12}$	...	...	Ditto ditto.
" " XVIII ...	Ditto ...	Ditto ...	Ditto ...	31	26	91	38	$\frac{1}{12}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{12}$	...	...	Germination thick; tillering fair; trace of rust.
" " XIX ...	Ditto ...	4th March 1912 ...	20th April 1912 ...	20	16	84	36	$\frac{1}{12}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{12}$	...	...	Germination thick; tillering fair; rust bad.
" " XX ...	Ditto ...	6th March 1912 ...	21st April 1912 ...	25	32	77	4	$\frac{1}{12}$	4	...	...	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering good; rust present.
" " XXII ...	Ditto ...	2nd March 1912 ...	Ditto ...	27	0	79	20	$\frac{1}{12}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{12}$	...	...	Germination regular; tillering fair; trace of rust.
(Standard) Type, No. IX...	Ditto ...	8th March 1912 ...	23rd April 1912 ...	34	16	99	8	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair.
Other wheats.																	
Choutra wheat (Kohat) ...	21st November 1911 ...	7th March 1912 ...	20th April 1912 ...	32	0	102	16	$\frac{1}{32}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{32}$	...	...	Germination regular; tillering fair; rust bad.
20 Sp. Bearded with white and hairy glumes and red grains.	Ditto ...	9th March 1912 ...	21st April 1912 ...	36	...	98	16	$\frac{1}{32}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{32}$	...	...	Germination rather thick; tillering fair.

N. B.—All the above wheats lodged just after irrigation on 30th March 1912. The grains had developed to a considerable extent by then. However, therefore, the outturns were little affected.

STATEMENT E.

Outturn of Barley varieties for the year 1911-12.

Area in acres.	Name of variety.	OUTTURN PER ACRE IN 1911-12			Detail of cultivation in 1911-12.	REMARKS.
		Mds.	Seers.	Cks.		
$\frac{1}{8}$	Lyallpur barley ...	35	12	0	Ploughings ... 4 Waterings ... 3 Weeding ... 1 Date of sowing 7th October 1911. Date of harvesting 8th April 1912.	Germination good.
$\frac{1}{8}$	Lahore barley ...	30	28	0		Do.
$\frac{1}{8}$	Cape barley ...	30	0	0		Do.
$\frac{1}{8}$	Black barley ...	26	8	0		Do.
$\frac{1}{8}$	Kulu barley ...	15	36	0		Germination good but attacked by white ants.

STATEMENT F.

Valuations of cottons.

No of variety.	Name of variety.	Price of lint per candy given by Tata & Sons, Spinners, Bombay.	Price of lint per candy given by Chamber of Commerce, Bombay.	Price of lint per candy given by the British Cotton Growing Association, Manchester.
	Acclimatized cottons.	Rs.	Rs.	Rs.
7 F	Dharwar American	320	305	312
70 F		290	295	281
72 F		325	320	315 *B*
110 F		285	300	306
111 F		320	320	327 *A*
112 F		315	312	315 *A*
126 F		295	310	315 *B*
161 A F	Lyallpur American	385	425	330 *A*
168 F	Dharwar American ...	320	315	324 *B*
199 F		290	310	312 *B*
226 F		285	275	278
232 F		280	270	275
233 F		285	280	306
246 F		320	324	324 *B*
266 F	Punjab Narma	295	290	294
267 F	Dharwar American	300	300	294
270 F	Punjab Narma	310	280	294
275 F	Sargodha Narma	300	300	303
276 F		305	295	303
280 F	Lyallpur American	...	380	318 *A*
	Newly imported Upland Americans.			
271 F	Mortgage lifter	340	365	324 *B*
272 F	Kings cotton	320	320	318 *B*
273 F	McCall cotton	310	320	318 *B*
274 F	Pride of Georgia	325	350	324 *B*
	Native cottons.			
28 D	F. S. broad leaf	275	265	272
		Price includes a rebate of 5½ per cent. Basis taken :— American good middling 7½ per lb. C. I. F. (on Rs. 385 per candy). Fine Narsari, Rs. 340 per candy. Do. Surat, Rs. 320 ditto. Do. Broach Rs. 285 ditto. Do. Warora, Hinganghat, Rs. 290 per candy (Central Provinces). Fine Wardha, Rs. 285 per candy (Central Provinces). Fine Yeotmahi Rs. 280 per candy (Berar). Good Tinnevelley, Rs. 320 per candy. Bombay, 10th May 1912.	Basis taken— Middling American at Rs. 340 per candy of 784 lbs, less 5½ per cent. Fine M. G. Broach at Rs. 290 ditto ditto. Ditto Narsari at Rs. 320 ditto ditto. Good Tinnevelley at Rs. 310 ditto ditto. All for ready delivery in Bombay. The Fine M. G. Broach rate this season owing to the crop being a poor one in quality and staple is comparatively low and quotation given for Fine M. G. Narsari is more reliable as a basis.	

A. Very suitable for Lancashire.
B. Suitable for Lancashire.
Tinnveelly fully good fair July to August.
Shipment $6\frac{3}{16}$ *d.* per lb. (304 rupees per candy) to-day (10th July 1912).

STATEMENT No. G.

Showing the outturn of Kapas (unginned cotton) and income for lint per acre, &c.

Area in acres.	No. of variety.	Name of variety.	Outturn of Kapas (unginned cotton) per acre.		Percentage of fibre to kapas (unginned cotton).	Length of lint in inches.	Produce of lint in lbs. per acre.	Value of lint per candy of 784 lbs. as derived from the mean of the valuations given by Chamber of Commerie, Bombay, Tata, Son and Co., Bombay, and the British Cotton Growing Association, Manchester.	Estimated value of lint per acre.		
			Maunds.	Seers.					Rs.	A.	P.
		Acclimatized cottons.									
$\frac{27}{166}$	7 F ...	Dharwar American ...	10	14	31	·9	262	312	104	4	6
$\frac{11}{154}$	70 F ...	Ditto ...	9	35	34	1	275	288	101	0	3
$\frac{11}{154}$	72 F ...	Ditto ...	9	32	29	1	229	320	93	7	6
$\frac{11}{154}$	110 F ...	Ditto ...	11	11	34	1	313	297	118	9	2
$\frac{11}{154}$	111 F ...	Ditto ...	10	2	30	1	247	322	101	7	2
$\frac{11}{154}$	112 F ...	Ditto ...	7	17	32	·9	192	314	77	2	10
$\frac{27}{166}$	126 F ...	Ditto ...	9	18	32	·9 to 1	248	307	97	2	2
$\frac{27}{166}$	161 A F ...	Lyallpur American ...	8	22	29	1·1	203	380	98	6	3
$\frac{27}{166}$	168 F ...	Dharwar American ...	8	14	29	1	196	316	76	11	3
$\frac{27}{166}$	199 F ...	Ditto ...	7	21	32	1	196	304	76	4	1
$\frac{27}{166}$	226 F ...	Ditto ...	9	25	31	·9	245	279	87	3	5
$\frac{27}{166}$	232 F ...	Ditto ...	8	32	29	·9	205	275	72	2	7
$\frac{27}{166}$	233 F ...	Ditto ...	11	26	31	·9	245	290	109	1	10
$\frac{7}{154}$	246 F ...	Ditto ...	11	3	33	1	299	323	123	3	11
$\frac{25}{154}$	266 F ...	Punjab Narma ...	11	30	33	·9	317	293	118	7	8
$\frac{25}{154}$	267 F ...	Dharwar American ...	11	24	32	1	305	298	115	14	11
$\frac{27}{154}$	270 F ...	Punjab Narma ...	11	0	32	·9	287	295	107	15	6
	275 ...	Sargodha Narma ...	9	18	32	·9	248	301	95	3	5
$\frac{7}{154}$	276 ...	Ditto ...	9	30	32	·9	256	301	98	4	6
	280 F ...	Ditto ...	...	...	32	1	...	333	...		
		Newly imported upland American cottons.									
$\frac{19}{154}$	271 F ...	Mortgage lifter ...	4	34	31	·1	123	343	53	13	0
$\frac{19}{154}$	272 F ...	Kings cotton ...	6	16	30	·9	157	319	62	9	8
$\frac{19}{154}$	273 F ...	McCall cotton ...	5	25	32	1	147	316	59	13	[illegible]
$\frac{19}{154}$	274 F ...	Pride of Georgia ...	4	2	32	1	106	333	45	0	4
		Native cottons.									
$\frac{1}{4}$	28 D ...	F. S. Broad leaf ...	4	3	33	·6	110	271	38	0	4
$\frac{1}{4}$	28 D ...	F. S. Narrow leaf ...	4	0	32	·6	...	...	...		
$\frac{1}{4}$	29 D ...	Lyallpur ...	5	24	33	·6	...	...	...		

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REPORT

ON THE

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OF

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PUNJAB,

For the year ending the 30th June 1913.

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1913.

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Proceedings of His Honour the Lieutenant-Governor of the Punjab in the Revenue and Agriculture (Agriculture), Department, No. 309, dated 20th December 1913.

READ—

Letter No. 937, dated 20th November 1913, from the Junior Secretary to the Financial Commissioners, Punjab, forwarding, with the comments of the officiating Financial Commissioner, the Annual Report on the Department of Agriculture in the Punjab for the year ending 30th June 1913.

REMARKS.—Some difficulty has been experienced during the year in filling up leave vacancies among the superior staff of the Department and College, and the Director reports that the work was hampered by the temporary curtailment of the staff. The appointment of a second Deputy Director will, however, effect an improvement in this direction, and it is hoped that in the near future the staff will be further increased by the appointment of a third Deputy Director and of an Agricultural Engineer.

2. The Lyallpur Agricultural College shows a serious falling-off in the number of students during the year under report. The scholarship and entrance examinations were held in May 1913, and, although 25 nominations were received for the scholarship examination, only 11 candidates presented themselves, of whom 7 were awarded scholarships. Similarly, 15 applications were received from candidates for entrance as fee-paying students, but only 7 presented themselves for examination and 5 were admitted. But of these 7 scholars and 5 other students, not one presented himself when the session opened. It is undoubtedly disheartening that the supply of fresh students, which has up till now been about 20 or 30 each session, should suddenly have ceased altogether; but there is no doubt that, though scientific agriculture is making steady progress under the Department, there is as yet no popular demand for an agricultural education. Education is still valued only as an avenue to employment, primarily under Government, and an agricultural training as yet provides comparatively few openings for youthful ambition. The work of the Department in awakening interest and convincing the people of the value of science applied to agriculture will no doubt in time create such a demand. Meantime the Director is afraid that the Department cannot exist unless the College turns out at least as many trained men as the Department requires, and is of opinion that the raising of the pay of the appointments under his control will result in increased entries at the College. His Honour had occasion, when in Lyallpur in August last, to refer to the apparent falling off in the popularity of the College and to the reasons for this falling-off. One of the reasons given was that the licentiates of the College were dissatisfied with their prospects. His Honour then undertook to do what was proved to be necessary to improve the lot of the licentiates, and he is prepared to consider any detailed proposals that the Director may put forward.

The Principal of the College draws attention to the weakness of the elementary education of the students who enter the College. He complains that their general education is so insufficient that they cannot readily assimilate the first year course. The Lieutenant-Governor has heard similar complaints in connection with other collegiate courses, and believes that they are in part due to the difficulty which a boy straight from school has in understanding English when he first hears it spoken by an Englishman.

With regard to the training at the College, he cannot too strongly insist on what he said at Lyallpur as to the necessity of maintaining the high standard which the College has set up.

The Lieutenant-Governor will await with interest the result of the deliberations of the Board of Agriculture on the subject of agricultural education, which is to be considered by the Board this month.

3. The innovation introduced this year of a short vernacular course during the cold weather months should, as the Lieutenant-Governor had occasion to remark at Lyallpur in August, prove of value in popularizing the College among the landowners of the Province, and the experiment will be watched with interest.

4. His Honour has already observed in his speech at Lyallpur that the success of an Agricultural College must depend largely on the interest of landowners, great and small, and he impressed on the College authorities the necessity of leaving no stone unturned in order to demonstrate to the public at large the value and possibilities of the scientific study of agriculture. His Honour welcomed the suggestion of the Commissioner that all officials, from Deputy Commissioners downwards, should be encouraged to visit and inspect the work going on in the laboratories and experimental farms, and he reads with pleasure in paragraph 18 of the report on the Gurdaspur Agricultural Station, that the station was visited during the year by two Deputy Commissioners from other districts, and by a number of Tahsildars and kanungos. His Honour is particularly gratified to learn that zaildars and members of the Co-operative Credit Societies visited the station, and he would be glad to see such visits both to Lyallpur and to Gurdaspur regularly organised on the lines suggested in paragraph 25 of the report. To get into touch with the people good working knowledge of the vernacular is indispensable, and he hopes the Director will impress this point on all European members of the staff. The recent appointment of a highly-qualified Indian gentleman who is also a native of the province as second Deputy Director should help to popularise interest in agricultural enterprise.

5. Experiments with wheat continue on the same lines as before, and the experience of the past year has tended to corroborate previous conclusions rather than to bring any fresh facts to notice. In the Gurdaspur farm the season was unpropitious, and no very satisfactory results were obtained, as the dry winds of April ripened the crops hurriedly and shrivelled the grain. An attempt was made to experiment with Ottawa wheat. In Lyallpur manure experiments were carried out, and the results were varied, but a large increase in the straw resulted from all the manures.

6. American cotton has been making great strides, and is now firmly established in Lyallpur and Jhang. It yet remains, however, to decide on a satisfactory indigenous cotton, and this is a most important point, as it is stated by the Director that the bulk of the Punjab crop will always consist of such cotton. The experimental farm which is to be established shortly at Hansi, where the conditions for canal-irrigated cotton are reported to be favourable, will be helpful in this investigation.

7. The Financial Commissioner congratulates the Department on the successful efforts made to combat the boll-worm by means of the parasite. The Director reports that the difficulty of keeping the parasites alive through the winter seems to have been overcome, and parasite boxes can now be sent out as soon as a boll-worm attack is reported. This is a useful advance, and should go far in preventing the extensive ravages of the cotton pest.

8. The experiments in olives at Khairi Murat, Gandalla and Sakesar under Mr. F. Mitchell's supervision are continuing, but, owing to the slow growth of the olive, no great results can be chronicled. His Honour recently saw the Sakesar experiments, and though their early stages were promising, they seem to have suffered from want of proper protection at a later stage. Elsewhere the area under supervision is being extended and grafting continues. Almonds are being interplanted with the olives in order to provide an intermediate source of profit till the slow-growing olives come to maturity. The almonds will be removed when the olives mature.

9. The poultry at Lyallpur have not been successful, and the Director is of the opinion that the climate of Lyallpur is unsuitable, and the farm should be removed to Gurdaspur. In view of the importance to the Province of improvements in poultry, it would be as well that a site should be carefully selected where the conditions would be favourable.

10. Demonstrations continue to be given and attract interest. The experiments in dry farming to be carried out at Basal in the Attock District should prove instructive. The agricultural associations are a new feature, but His Honour entirely concurs in the view expressed by the Financial Commissioner that co-operative societies offer the most promising agency for furthering the object in view, *viz.*, the practical application of scientific methods to every-day agriculture. He has been glad to observe in his tours in Gurdaspur and elsewhere that the co-operative societies are of their own motion taking steps to promote agricultural improvements among their members by arranging for the supply of selected seed, up-to-date implements, etc., and he would be glad to see the Agricultural Department making more use of the co-operative movement in the many districts where it is now formally established.

11. With the exception of the unsatisfactory state of the College, which is due to causes which are beyond the control of the Department and which there is reason to hope will disappear with the spread of agricultural knowledge and enlightenment, the year has been one of progress, and the Department continues to do good work and to extend its operations. The Lieutenant-Governor at his visits to the Lyallpur and Gurdaspur stations was much struck with the zeal and devotion to duty of the staff of the Department.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Junior Secretary to the Financial Commissioners, Punjab, for information; that they be published in the *Punjab Gazette*, and submitted to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor, Punjab,

J. P. THOMPSON,

Revenue Secretary to Government, Punjab.

2417 CS—517—22-12-43—SGPP Lahore.

No. 937.

FINANCIAL COMMISSIONERS' OFFICE:

Dated Lahore, 20th November 1913.

FROM

J. M. DUNNETT, ESQUIRE,
Junior Secretary to the Financial Commissioners, Punjab,

TO

THE HON'BLE MR. J. P. THOMPSON,
Revenue Secretary to Government, Punjab.

The Hon'ble Mr. A. H. Diack, C.V.O.

SIR,

I AM directed to submit the annual report on the operations of the Department of Agriculture, Punjab, for the year ending 30th June 1913, together with a separate note containing the comments of the Hon'ble Mr. P. J. Fagan, officiating Financial Commissioner.

I have, &c.,

J. M. DUNNETT,

Junior Secretary to the Financial Commissioners, Punjab.

Note by the Hon'ble Mr. P. J. Fagan, Officiating Financial Commissioner.

The College.

The College, with which the welfare of the department is closely bound up, is in a critical position. Candidates for admission have fallen from 78 in the preceding year to 40 in the year under report. Nominations show a decrease from 35 to 25, and applications from fee-paying students numbered only 15 against 43 previously. Again no nominations have been received from the Lahore division. The Financial Commissioner is inclined to think that the remark made by the Deputy Commissioner, Lahore, in his reply to the enquiry mentioned in paragraph 1 of his note on last year's report that "zamindari families, perhaps influenced by the neighbourhood of the capital of the province and the general educational facilities which it affords, prefer to give their boys a general education which they think better fits them for advancement in life" reflects a tendency more highly developed in the Lahore division than elsewhere. But Mr. Fagan regrets to note that the College has not received adequate support from any portion of the province.

From the 12 candidates selected for admission not a single one has presented himself at Lyallpur, and there is now no first year class. The absence of entrants and the low educational qualifications of candidates are questions which will come under discussion in the Board of Agriculture in December, and the Financial Commissioner does not propose to do more than mention them here, more especially as they arise in an equally acute form in other provinces. The conclusion which he is disposed to entertain, at all events provisionally, is that for a considerable period to come agricultural education must be content to wait upon agricultural research and, in agreement with the Director of Agriculture, he is, as at present advised, opposed to a lowering of the educational qualifications required for entrance. The Financial Commissioner has not been able to support Mr. Hamilton's proposals that diplomates should be entertained for a year or two as temporary agricultural assistants, with the object of giving them practical training on Court of Wards estates in the work and duties of managers. Mr. Fagan does not consider that previous Government orders contemplated that the College should be in a position to provide from among the diplomates fully trained estate managers. The approved objects of the diploma course would appear rather to be the provision of future agriculturist teachers, research workers and suitable incumbents for posts in the Agricultural Department. Their College training, however, would no doubt help many if not most of the diplomates to qualify themselves in due course for managerships by practical experience gained after leaving the College.

Research and experiment.

2. Valuable research and experimental work continued to be done at the Lyallpur and Gurdaspur stations. Experiments with wheat have merely confirmed the results of previous years. The unsuitability of Pusa wheats for the Punjab emphasizes the importance of the wheat survey, which continues to be carried on. The report is silent as to the home market values of selected red wheat,—a subject to which attention was directed last year in the Financial Commissioner's review and in the orders of Government. Mr. Fagan understands that, owing to the bad quality of this year's wheat, the Director found himself unable to obtain samples suitable for the home market. The subject should be noted in next year's report.

Cotton.
Sections 9—11.

The Financial Commissioner's anticipation of last year that with a favourable season good results should be obtained with American cotton has been verified. The yields have been heavy, and the demand for seed has outrun all supplies in sight. But it is unfortunate that success so far has been confined to the selection of varieties suitable for cultivation on the best colony lands only. Mr. Fagan agrees with the Director that the selection of types suitable for distinct localities is of immediate importance.

The results of the efforts to encourage successful hibernation of the boll-worm parasite, (section 16 of report), constitute a long step in advance towards the protection of the cotton crop from insect pests, and are matter for congratulation.

Cane.
Appendix VI, section 4.
Appendix VII, section 4.
Appendix III, section 3.

Section 2, last year's review.
Appendix V, section 4.

Experiments with varieties of sugarcane are still in an early stage. Mr. Barnes has printed a preliminary note on his survey of the sugarcane in the Gurdaspur district. The results hitherto obtained do not go very far, but they indicate that the line of investigation which is being pursued is likely to be a fruitful one in the near future. It is proposed to extend the enquiry over a number of seasons so as to eliminate the climatic factor. Experiments to determine an effective method of combating the moth borer in young sugarcane appear to the Financial Commissioner to require continued and more energetic prosecution.

Demonstrations.
Appendix I, section 7.

Appendix I, sections 2 and 7.

3. The demonstration work at Lyallpur and Gurdaspur continues to be attractive and successful. The starting of three demonstration plots in Jullundur district and the lease of land in Attock district, both for the demonstration of methods of dry farming, are interesting developments of the department's work. The readiness of implement makers to extend their agencies beyond the Chenab Colony confirms the belief that implement demonstrations in the older districts have great value.

Report, section 23.
Appendix I, section 8.

Report, section 26.

The six agricultural associations—a new feature of the year under report—have been employed chiefly in the distribution and use of improved implements. In this way the department has been able to distribute on loan 148 ploughs and harrows. While agreeing with Mr. Hamilton that complete unification of agricultural associations and co-operative credit societies is in many ways undesirable, the Financial Commissioner is inclined to think that to confine each organization to a clearly and rigidly limited sphere, as proposed in section 26 of the report, is to miss valuable opportunities. Co-operative societies will, it may be confidently anticipated, constitute a very valuable agency for the ultimate widespread distribution of superior implements and other agricultural requirements as well as for the propagation of improved agricultural methods, and the sooner their aid is enlisted, whether through individual members or more directly, the earlier may we expect to see an increased rate of progress. Agricultural associations have their uses, but are not free from the temptation to become merely permanent channels for loans from the department.

Report, section 17.

4. Sericulture has had to contend with ignorance and slovenliness among rearers, and poultry rearing with unfavourable climatic conditions. But in view of the moderate aims in the one case of providing the poorer peasants with a considerable subsidiary income, and in the other of improving the indigenous breeds, the results of the year's working need not cause discouragement.

Good progress has been made by Mr. F. Mitchell in bringing portions of the Western Punjab hills under olive cultivation, and the study and improvement of date-palms is proceeding on proper lines.

The small success of the well-boring operations is matter for regret, considering the value of the work and the readiness of the well-owners to acknowledge its usefulness. Greater energy on their part in rendering practical assistance would be beneficial. The supervising staff also is numerically weak, and this defect can hardly be remedied by trying to transfer all responsibility for supervision to the Deputy Commissioner and his subordinates. Improved results may be expected when the Agricultural Engineer is appointed.

Report, section 27.

5. The question raised in paragraph 28 of the report is under the consideration of the Financial Commissioner. There are some practical objections to the proposal made by the Director of Agriculture, and the Financial Commissioner is doubtful whether the difficulty with which it is intended to deal is likely to be so common as to call for special measures. With reference to the second proposal to which the Director alludes in paragraph 29 of the report it may be observed that it received only a qualified support from the Financial Commissioners.

General working.

6. The comparatively meagre educational results obtained from the Agricultural College both in themselves and when compared with the expenditure incurred are disappointing. This is not, the Financial Commissioner thinks, due to any inefficiency on the part of the staff, but rather to the fact that an attempt is being made to supply a form of education for which there is at present no really effective demand, though it may be anticipated that it will arise in due course as interest in and desire for agricultural improvement is awakened and fostered in rural circles. As regards the remaining work of the department the Financial Commissioner considers that the Director and the staff are to be complimented on the general success of the year's operations which augurs well for the steady growth of systematic knowledge regarding the agricultural conditions of the province and for the gradual but effective improvement of agricultural methods.

281 FC—450—22-11-13—SGPP Lahore.

ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH *JUNE* 1913.

Personal.

1. I held the post of director throughout the year but was on privilege leave during July to September when Mr. Gibson officiated. The scale of the superior staff of the department has remained unchanged. Mr. Barnes, agricultural chemist and principal of the college, took six months' leave in the hot weather of 1912 and Mr. Roberts, the professor of agriculture, officiated as principal and Mr. Annett, supernumerary chemist, officiated as agricultural chemist. During the present hot weather Mr. Roberts has taken six months leave : the government of india were unable to provide a supernumerary agriculturist and Mr. Southern, deputy director, had to be appointed professor of agriculture. This left us with no imperial officer at all for district work and M. Fateh-ud-din, assistant director of agriculture, acted as deputy director. This temporary reduction of our already exiguous staff has of course been a serious hindrance to work, but I need not dilate on this, as sanction has been given to the appointment of a second deputy director, and I understand that proposals, which have been sent in for a third deputy director and an agricultural engineer, will be accepted. Some arrangement for filling up leave vacancies in the imperial staff is urgently needed, but will presumably be worked out for India as a whole. Mr. Roberts has worked hard and shewn good judgment in the management of his farm : Mr. Southern will do excellently as soon as he has mastered the vernacular. Since the close of the year I have appointed a second assistant director from among the agricultural assistants and have appointed five new agricultural assistants from the students who obtained their diplomas this year. One of the agricultural assistants appointed last year has been selected as research assistant in entomology and will be sent to Pusa for training. Mr. Ramgopal, assistant professor of botany, has been appointed director of agriculture in the Kashmir state, and Lala Jai Chand, who was professor of biology in the Dyal Singh college, has been appointed in his stead.

The College.

2. I need add little to what the principal has said in appendix II. We are now at a crisis in the history of the college, for not a single student out of those referred to in paragraph 11 has entered the college and there is no first year class for the diploma course. I agree with Mr. Barnes that the reason why the college fails to attract is that the attainment of the diploma of licentiate in agriculture does not command sufficiently remunerative employment outside the agricultural department, and within the department the scale of salaries and especially the rates of increment are too low. This year the man who stood first in the diploma examination and won two medals will not accept the post of agricultural assistant on Rs. 40 per mensem which is all I can offer him. As regards the department I propose to ask government to improve the pay, so that it may be able to attract the best men who obtain the diploma If the department is to continue to progress—even merely to continue to exist – at least so many first class men must be trained at the college as will furnish the recruits required to man the department. If they are not to be obtained, the department must collapse. Outside the department I do not see that anything can be done. So far as government service is concerned, the licentiate in agriculture has already been declared to be equivalent to the B. A. for appointment in government service, but I do not think it really counts for as much either in official or in popular estimation. This will come in time. As to private work - whether scientific research or farm management—there is no opening yet for the scientific agriculturist.

A more fundamental difficulty lies in the weakness of the elementary education of the students to which Mr. Barnes refers in paragraph 3. I am not aware how far this difficulty is experienced in other colleges : if it is not felt, it must be because the instruction in other colleges starts from a lower stage than at Lyallpur. I am not in favour of lowering the standard at Lyallpur, and if matriculates are incapable of assimilating the course, then the lowest qualification for entrance will have to be a certificate of success in the F. A. examination.

The whole question of agricultural education is to be discussed in the Board of Agriculture in December.

The Vernacular Course.

3. The vernacular course (paragraph 5 of appendix II) was more or less experimental last year. A full prospectus has now been issued in English and vernacular and widely distributed. A class of 20 or 30 will be recruited with care, largely on the recommendation of agricultural banks, from the sons of cultivating owners who have passed through a primary school. The course should be of great value in spreading into the districts a knowledge of the agricultural implements and methods which have proved successful on our farms. Further particulars as to the course can be ascertained from the prospectus.

Elementary English course for Assistant Commissioners.

4. The short English course for newly-joined assistant commissioners will be placed on a permanent footing this year. It is under consideration whether the course should not be made obligatory for extra assistant commissioners and other revenue officials of the higher grades who know English.

Need of post-graduate practical training.

5. I was reproved last year for stating in my report that our aim should be to turn out from our college the scientific, not the practical, farmer. Accepting the practical farmer as our aim, it still is certain that at Lyallpur we do not and cannot turn out a practical farmer, and I do not think any college in the world professes to turn out men who, without further training, will be practical experts in the art of which they have been learning the basic sciences. Every college graduate needs one or two years of practical experience before he can be of much use either as departmental agricultural assistant or as an expert agriculturist under a court of wards or a district board. I am now being frequently asked for experts by district boards and courts of wards but cannot supply them. This year the number of diplomates has been so small that I have been able to enlist all but one of those who were recommended by the principal for government service. As agricultural assistants they will be trained, and after a few years can be passed on for service under local bodies or private persons. But if the college can turn them out, we need to train more men than can be appointed to the department. I submitted proposals for training these men in January last, but no arrangements have yet been sanctioned. The matter is a most important one, as the ability of the department to provide districts with really expert agriculturists will depend on some suitable arrangements for practical training being made.

Research and experiment : (*a*) Wheat.

Appendix VI—3, 6, 8, 9.
Appendix VII—10-16.

6. As regards wheat the experience of the year has corroborated past results, but has not produced anything new. The wheat yields shewn in statement No. XIII are very satisfactory, while those in statement No. X show the enormous increase of straw, which can be obtained by manuring. The outturns on the Gurdaspur farm have been much below those of last year for the reasons given in paragraph 2 of appendix VII. It may be taken as established that wheat of Punjab type 11 is the best we have for the Chenab and Jhelum colonies, and that types 13 and 14 are the most suited for the unirrigated wheat tracts both in the north-west and in the centre of the province.

Appendix I—10, 11.
Appendix VI—9.

239 maunds of No. 11 were sold for seed in 1912: the issue of Nos. 13 and 14 was spoiled by the mistake of having the Gurdaspur wheat steam threshed by an inefficient thresher which cut a great deal of the grain. We now have on hand

about 936 maunds of No. 11,
„ 242 „ „ No. 13,
„ 43 „ „ No. 14,

and arrangements have been made for the multiplication of this in privately owned lands and on the Sargodha seed farm. The seed will be grown in the tract in which the type is at present commonly found and will be sold in the following year to cultivators in that tract. We shall thus be able to work out from centres and gradually establish a pure variety of wheat throughout a considerable area. By insisting on hot weather ploughing with Raja ploughs on these seed farms, we hope at the same time to provide a demonstration of successful wheat cultivation.

Appendix VI—8.

Pusa wheats.

Appendix VI—9.
„ VIII—11—14.

7. None of the Pusa wheats except No. 12 appears to be suitable for the Punjab. They give a poor yield and are very liable to rust. No. 12 is a white wheat of very fine appearance which has yielded well and some seed will be sold this year to zamindars in barani tracts.

In a publication of January 1913 by Messrs. Howard and Leake the softness and poor appearance of the Pusa wheats grown at Lyallpur were ascribed to over irrigation. With a view to test this theory, half of several fields were deprived of the final March watering (*vide* statement No. XV in appendix VI). The outturn results are inconclusive: the nitrogen analyses and consistency determinations have not yet been completely worked out.

Wheat survey.

8. The survey undertaken this year showed the following to be the commonest wheats in the tracts surveyed:—

See paragraph 81 of Colonel Montgomery's Settlement Report.

Hoshiarpur.—Types 14 and 15 (*káthi*) are commonest throughout the district; type 13 (*dhamuri* or wasp coloured) is almost as common as 14 in the Dasuya tahsil and predominant in bet lands: it is found in many villages of Hoshiarpur tahsil. Type 16 (*daudkháni*) is pure in some villages of Dasuya; and 17 and 21 (both beardless with amber coloured grain) (*kanku*) are the chief wheats in the Dun tract of the Una tahsil and 17 in the hill lands of the Dasuya tahsil.

Gujrat.—Types 14 and 15 (*nikki kanak*) are predominant throughout the district; types 17 and 18 (*ghoni*) are not uncommon in the Phalia tahsil; and type 1 (*wadának,* locally known as *dágar*) is common in parts of Gujrat tahsil.

Lyallpur district (*Samundri and Toba Tek Singh tahsils*).—Type 11 forms between 80 and 90 per cent. of the wheat crop. Beardless wheats occupy some 10 to 15 per cent. of the wheat area and are chiefly of types 17 and 20.

(*b*) Cotton.

Appendix IV—5.
„ VI—10.

9. The printed note "On cotton improvement in the Punjab," which is annually revised, gives full information as to the progress made. As to American cotton I need add little to what is said by the economic botanist and the professor of agriculture. We now have several strains of good staple which appear to be safe and heavy yielders. The next step is to discard the less profitable of these and concentrate our efforts on one, two or at most three of them. Messrs. Tata and Sons in their report on the samples sent to them by the economic botanist note that the samples are of mixed staple, *i.e*, the fibre is long and short and weak and strong in the same sample, which seriously detracts from the value of the cotton. This shows that if we are to grow American cotton with uniform staple, uniformly good land must be used.

American cotton is now firmly established in Lyallpur and Jhang and will probably succeed in Shahpur too. The main duty of the department in the future will be the maintenance of a supply of pure seed for these tracts. About 400 kilas are now under 3 F and about 100 kilas under 4 F under an agreement with the growers that all the cotton produced up to December 15th shall be sold by auction in the Lyallpur mandi under the supervision of the professor of agriculture. The ginning will be under departmental supervision and a premium will be paid for seed and ginning. The premium should be recovered when the seed is sold to the cultivators. If the crop on the seed farms is good this year, we should have American seed for some 10,000 acres at least available for the spring sowings.

Appendix I—10.

With indigenous cotton the progress has been much less satisfactory. Pure varieties of *Gossypium Sanguineum* have been grown on the Lyallpur farm for some years and one of these is now being grown on seed farms. It will be sold to cultivators in the spring. But this cotton is grown only in the south-west of the province. For the remainder of the province we require pure varieties of *Gossypium Indicum* and *Neglectum.* The so-called Hansi cotton hitherto grown on the farm was a mixture and all of it has this year been discarded. So far the economic botanist has not handed over any pure variety to the professor of agriculture. He has, however, several varieties on large areas this year and should be able to hand over the best of them in the cold weather. The great bulk of the Punjab cotton crop will always consist of one of the indigenous short stapled varieties, and it is most important that there should be no further delay in deciding which type in each of the local mixtures is the most profitable and in multiplying that locally.

Appendix IV—6.
" VI—10.

A survey of the cottons of the Lyallpur district was carried out in the autumn of 1912 and showed the following cottons to be prevalent :—

Cotton survey.
Appendix I—9.

Lyallpur Tahsil.—*Gossypium Indicum* yellow flowered.

Toba Tek Singh.—*Gossypium Sanguineum* both broad and narrow leaved chiefly near Gojra and *Gossypium Indicum*—yellow flowered—in almost as great quantity.

Samundri and Jaranwala.—*Gossypium Indicum,* yellow flowered and *Gossypium Neglectum* yellow flowered in almost equal quantities.

There is everywhere a fairly considerable admixture of the white flowered varieties of *Gossypium Indicum* and *Neglectum,* and these popular opinion regards as heavier yielding. Certainly the percentage of lint is higher in the white flowered varieties grown in the Lyallpur station. *Gossypium Sanguineum* is not uncommon in the Lyallpur and Samundri tahsils, but is the predominant type in few villages.

Two or three districts are to be surveyed this month.

10. The deputy director and I have just selected land for a large cotton farm near Hansi, which is the best known irrigated cotton tract in the province. The selections of the economic botanist will be grown here as well as at Lyallpur. The barani cotton will have to wait a bit yet.

Cotton farm at Hansi.

11. The practice of damping cotton has been much discussed during the last year. In the Punjab the zamindar or village bania does not damp his cotton (*kapas*) before it is taken to the gin : at the worst he may keep it for a short time in a damp place such as an empty water-course, but any moisture which the cotton may take up in this way will be removed while it is lying in the factory before ginning and during the process of ginning. In some cotton presses it is undoubtedly the practice to lay the cotton (*rui*) on wet ground before it is baled : in only one factory

Cotton damping.

have I found a hose in use for spraying the cotton before baling. It is not only the owners of ginning and pressing factories who gin and press their own cotton who practice damping. Some exporting firms (or their agents) have their cotton damped before baling. However, damping is not general; attention has been drawn to the damage done to the cotton, and if exporting firms will prohibit it in the case of their cotton, I think the owners of ginning factories will also stop it in the case of their own cotton.

Manures.

See also Statement XVI.

12. The results of green manuring given in paragraph 12 of Appendix VI are specially interesting. So far we have not succeeded in persuading many cultivators to adopt the practice, the reason being that they grudge taking any water from cotton to give to a crop which is not immediately productive. Efforts are being made to extend the practice through the agricultural association of Lyallpur.

Appendix VI—8.

The only other manure which appears likely to be economical is bone meal and lime for wheat.

Appendix VI—6.
" VII—16.

Calcium nitrate, to be profitable, must be much cheaper than the present price of Rs. 10 the maund.

Chemistry.

13. I have nothing to say about the work reported on in appendix III. The enquiries which Mr. Barnes has in hand are of great importance, but most of them are too technical to be understood by the lay mind. It is a great pity that Mr. Barnes' duties as principal of the college necessarily restrict his research work. In both capacities Mr. Barnes is doing excellent work for government.

Botany and mycology.

Appendix IV—7.

14. Appendix IV is a record of the botanical work done. I hope Mr. Milne will in future be able to concentrate his efforts on the important botanical problems in connection with cotton, maize and wheat, which require working out. The discovery of the cause of root rot in cotton is of great interest, and I hope a preventive will soon be discovered.

Date-palms.

Appendix IV—9.

15. The Arab date grower who was engaged for three years has completed his term and has gone home. The following plantations were established in 1910 and 1911 :—

	Trees planted.	*Trees surviving, January* 1913.
Central Gaol, Multan	953	400
Taleri Bagh, Muzaffargarh ...	444	303
Victoria Memorial Hall, Muzaffargarh.	216	105
Rakh Chabri, Dera Ghazi Khan ...	420	253
Lyallpur	59	46
	2,092	1,107

In 1912 a plantation was started with 808 trees in Leiah, and many gaps were filled up in the older plantations mentioned above. During the three years about 1,900 trees have also been given or sold to various canal officers, to the Bahawalpur state and to private date growers. Altogether 5,166 trees have been imported. No trees are being imported this year, as it is advisable to ascertain how those already planted promise to turn out and which varieties are most suitable. We have little check over the purchase of trees near Basra and we do not know whether we are receiving good varieties or mere trash. Now that some of the trees are bearing fruit, the economic botanist is identifying the varieties as far as possible. Importation may be necessary next year to meet private demands and to fill up gaps. Our ultimate aim should, however, be to replenish our plantations with suckers from the trees already imported.

The pamphlet which is in the press will be of great assistance to date growers.

Entomology :
(a) Boll-worm.
Appendix V—6-11.

16. Appendix V describes the entomological work being done. We seem to have overcome the difficulties of maintaining the boll worm parasite in existence during winter, and we are now ready to send out the parasites as soon as a boll worm attack is reported. What we shall do is to send out parasite boxes—which are oblong boxes with fine wire netting covers—filled with parasitized boll worms to villages where boll worm is bad. The parasites (*Rhogas Lefroyi*) will get out of the boxes through the netting and lay their eggs in the boll worms in the cotton bolls. The whole of the life of the parasite is compressed into 9 days, so reproduction is rapid and the parasite is soon established. Over what area it will spread is not however known. Deputy commissioners will be asked to fill other parasite boxes with infected bolls from the fields in which the original parasite boxes have been placed and to place them in other villages where the boll worm is prevalent and the parasite can from that prevalence be guessed to be absent. A second centre of parasites will be established here and used in its turn as a store from which to pass on the parasite. In this way the parasites can be rapidly extended over a district. But the department has not staff enough to do more than put out the first parasite boxes, and we must rely on the deputy commissioner to arrange that small boys do not disturb the boxes, and that the multiplication of the boxes and their extension from tract to tract are carried out with intelligence. The assistant professor of entomology and his assistants will, as far as possible, ascertain how far the parasite has been established in places where there are parasite boxes. From enquiries that I receive it is clear that the object of parasite boxes is not understood, notwithstanding our instructions, by some of even our best deputy commissioners and I write this paragraph chiefly as a guide.

(b) Sericulture.
Appendix V—12.

17. Sericulture cannot spread much in the Punjab outside the submontane districts ; for elsewhere the season between the opening of the leaves on the mulberries and the setting in of the hot April winds is too short. We have this year taken a good step forward. Gurdaspur is the only district in which sericulture is established. The seed for that district is distributed by Khan Bahadur Shaikh Ghulam Sadik, who takes a lease of all the district board mulberry trees. Last year the amount distributed was 399 ozs. and the yield was only 47 maunds of dry cocoons. Seventy kilogrammes (77 seers) of green cocoons equivalent to about 25 seers of dry cocoons is the outturn in France of 1 oz. of seed. So with very moderate care on the rearers' part the yield in Gurdaspur should have been at least 120 maunds. The bad results are due to the rearers' inveterate adherence to dirty methods and under-feeding. They will not listen to advice and even the loan of racks which I tried this year in one village did not result in the racks being used. I fear we shall not be able to convert the rearers in this district to better methods.

The advance made this year is that outside the Gurdaspur district we have had the rearings carried out by villagers in their own homes instead of by canal officers, where rearings did not really achieve the object aimed at, namely, a demonstration open to the surrounding villages. The arrangement this year has been that we selected rearers in villages near mulberry plantations and the canal department issued passes to the rearers for the collection of leaves. 44½ ozs. of seed (out of a total of 51 ozs. issued) yielded nearly 8 maunds of dry cocoons. Considering that most of the rearers had never before seen a silk worm, the results were fairly satisfactory—surprisingly so in the Rupar and Kasur tahsils. We shall be able to issue about 150 ozs. next year.

The Salvation Army reared 12 ounces of seed in the serai at Changa Manga, where they have a settlement of criminal tribes. The mulberry leaves are obtained from the enormous mulberry forest close by. The outturn was just under 3 maunds of dry cocoons. Commissioner Booth Tucker ascribes the failure to obtain better results to—

(1) irregular and prolonged hatching ;

(2) over-crowding in the last stage.

Overcrowding and the difficulty of collecting sufficient leaves in the last stage will always be felt when rearings are centralized.

I held an exhibition of cocoons at Gurdaspur in the last week of May and distributed a good deal of money in prizes. This is a revival of a practice which was in force for many years when silk rearing was carried on at Madhopur. The exhibition will be annual. It is unfortunate that it must be held almost at the hottest season of the year. There is also no building in Gurdaspur which will house the bulky exhibits.

Acting on a suggestion of Commissioner Booth Tucker of the Salvation Army I am arranging for small rearings of worms next spring by boys in primary schools, near which there are mulberry trees. I am sure sericulture promises to the poorer peasants an easy and almost certain way of earning Rs. 30 or 40 by six weeks' work. For complete success we must secure earlier and evener hatchings. Next season we shall try hatching out all the seed of a village in a castelet, so as to get evener results. For earlier hatching we must have a small plantation of bush mulberry in every village in which sericulture is taken up. I have tried this year to get such plantations started through the deputy commissioners in the shamilat of some villages, but I do not think much has been done. With a little more persuasion something may be achieved.

I have asked the deputy commissioners of submontane districts to supply me with maps showing in what villages there are 20 or more mulberry trees. We shall distribute seed according to these maps and shall advise the maintenance and replacement of the mulberries in those places where sericulture is really taken up.

Smyrna figs.

18. There are now established at Lyallpur about 20 Smyrna fig trees, which were sent out to us by Lieutenant-Colonel Henderson, late I.M.S., who was a pioneer of improved horticulture when in the Punjab, and is ever ready now to assist us from England with advice and with seed and cuttings. Male fig trees were received only last year. Some of the Smyrna figs have borne a few fruits which have apparently been fertilized by an indigenous wasp; but as the figs seem to ripen two months later than the country figs when the wasp has reached the maggot stage, it will probably be necessary to import blastophaga from Smyrna, so as to ensure the regular fertilization of the figs.

Olives.

19. As directed in paragraph 6 of the review of last year's report, I give a short summary of a report by Mr. F. Mitchell of Kashmir on his work on olives in the Punjab. Owing to deficiency of water, trespass by cattle and want of supervision no progress has been made at Sakesar and it is proposed to hand the work of guarding existing olives there to the forest department. At Khairi Murat in February last there were 2,000 grafted trees on about 30 or 40 acres. Forty-three acres have since been cleared of roots and between 2,000 and 3,000 trees grafted. Local men are being trained as budders. As it is impossible to terrace the land "gamlas"—apparently circular trenches—have been made round the roots of a number of the grafted trees. They have greatly improved the growth. At Gandalla work has been begun this year. Ten acres have been cleared of shisham and planted up with young grafted olive trees prepared in the gardens at Lahore and Choa Saidan Shah. Where wild olives are in existence they are being grafted as quickly as scions can be made available. About 40 acres of olive jungle have been cleared of all other growth, and vacancies have as far as possible been filled up with grafted and ungrafted trees. To get a profit from the land while the slow

growing olive is maturing it has been decided to interplant with almonds which after 10 to 15 years in full bearing can be removed by the time the olives attain their maturity. No diseases of importance except a parasite of the wild olive and thought to be an aphis have attacked the young olives. The expenditure so far has been Rs. 7,474.

I hope this summary is correct, but, as I have no connection with the work, it is difficult to record progress in the proper perspective.

Poultry.

20. Poultry have done very badly at Lyallpur. Early in the year it was decided to keep only the following breeds pure :—

(1) Kashmiri Lolabi black.
(2) Rose comb Minorcas.
(3) White Orpingtons.
(4) White Wyandottes.
(5) Buff Orpingtons—to be newly imported :

and also Baghdad turkeys and mammoth bronze turkeys. The professor of agriculture decided to pay special attention to indigenous breeds and to try and improve them by crossing with pure breeds. The mortality has, however, been so great, as the figure below will show, that no progress has been made. The chief causes have been heat, roup and egg bound.

	Birds in July 1912.	*Birds in June* 1913.
Fowls	85	57
Chicks	98	77
Turkeys	10	11
Turkey chicks	14	22

From July 1912 *to June* 1913.

	Eggs laid.	*Eggs set.*	*Eggs hatched out.*	*Chicks died.*
Fowls ...	1,441	1,188	483	406
Turkeys ...	74	74	30	8

It is doubtful if poultry will ever succeed in a bad climate like Lyallpur unless they are allowed to run wild. Probably the experiment should be abandoned or transferred to Gurdaspur. In paragraph 7 of the review of last year's report I was requested to notice the results obtained at the central poultry station in Lahore, which is part of the zoological gardens and not under the department of agriculture. The report sent to me shows that white and buff Orpingtons, Minorcas and Leghorns are the chief breeds kept. The demand for chickens and eggs is on the increase. There is no demand for cross breeds. Incubators are used from October to March, but the chickens hatched out in them are weaker than those hatched under hens. Between March and June 1913 there were 80 deaths among the chickens from small-pox. Spirochætosis has also visited the farm, but injections of soamin have been successful. There are now 160 chicks on the farm. The income for the year ending April was Rs. 893 : the expenditure is not given.

Cotton cake as cattle food.

21. In addition to the experiments noticed in paragraph 10 of appendix VI I sent out about 500 maunds of undecorticated cotton cake made in Lahore for sale in a few markets of the Punjab, where cotton seed is regularly fed to milch cattle. It was sold at Rs. 2 a maund, when cotton seed was about Rs. 2-12-0 a maund. Notwithstanding the lower price it was difficult to sell the cake, and those who used it generally reported that buffaloes fed on it gave less *ghi* than when cotton seed was used. No digestive trouble from the use of the cake was reported. This trial does not show much, as the people seem to have been put off by the dry appearance of the cake more than anything else. The cake will be fed to the dairy cattle at Lyallpur under strict control, and more certain results will be obtained.

The consumption of cotton seed in the Punjab as cattle food amounts to some 49 lakhs of maunds annually, the whole of the Punjab production (not required for seed) being used in this way besides some 14 lakhs of maunds imported from other parts of India. The Punjab is therefore peculiarly interested in the substitution of cotton cake for cotton seed which must be popularized before an indigenous oil pressing industry can be economical and agriculturally sound.

Dry farming farm at Basal.

22. I have arranged to take on lease from next rabi some 20 acres of land at Basal in the Attock district. This land is in a tract where a great deal of wheat is grown and the rainfall is about 17 inches per annum. It will be farmed by the department so as to demonstrate the methods of dry farming. This was mentioned in paragraph 14 of last year's report; but the actual taking up of the land had to be postponed because of our difficulties as to superior staff.

Agricultural associations.
Appendix I—8.

23. The establishment of agricultural associations in six districts marks the definite advance of the department from experiment and enquiry to the greater task of conversion and conquest of old custom. The associations are not all constituted alike, indeed in some cases permanent members have not been appointed. The constitution of all will however be placed on a proper footing during the next year, and membership of the agricultural associations will I have little doubt be recognized as a distinct honour. In those districts where agricultural banks exist a large part of the members of the associations will be members of the agricultural banks or co-operative unions. We are insisting on all members carrying out in their own lands at least one practical demonstration of some method of cultivation or of some implement of proved usefulness. At first these demonstrations may not be very thorough, but we have already found that members who neglect the work entrusted to them can easily be put to shame. The more the department is known the readier the members of associations are to carry out its wishes.

The best way in which to prove to the cultivator that our implements or methods are profitable is to let him make trial of them himself in his own lands, and this is the course we are following in lending out ploughs, &c., as noticed in paragraph 8 of appendix I.

Demonstrations are also given at cattle fairs and elsewhere and attract considerable interest, but these are nothing like as good means of conversion as a trial by the cultivator himself on his own lands.

Sale of implements.
Appendix I—1-6.

24. The implements most commonly recommended—Raja ploughs, spring tined harrows, reapers and fodder cutters,—are stocked by Messrs Volkart Brothers at Lyallpur. Messrs. Marshall & Co. stock reapers. For the future Ransomes, Sims and Jefferies, also at Lyallpur, will sell their own ploughs. Owing to the assistance given by these private firms our implement depôts at Lyallpur and Gurdaspur have not lately been doing much business, their sales being confined to American horse hoes, Planet junior implements and chain harrows. There has been understocking, but orders have recently been sent for a supply of a few hoes and harrows.

The purchases by the public in the past year have been about—

Raja reapers and mowers	15
Raja ploughs	169
Meston ploughs	352
Other ploughs of Ransomes, Sims and Jefferies	60
Spring tined harrows	54
Hoes of sorts	9
Fodder cutters	33

Visitors to the farms.

25. The financial commissioner on my suggestion has recommended to deputy commissioners that tahsildars and kanungos should be sent for a couple of days to the farm at Lyallpur or Gurdaspur to see the work which is carried on there and so get some acquaintance with what is being done.

A large number of these men have seen our farms in this way. Canal officials are also sent on similar visits to our farms. I think these visits should be encouraged in every way, and that deputy commissioners and extra assistant commissioners should come as well as tahsildars. But better organization is necessary. Men should be sent in bands of about 20, for it is just as easy for the farm manager to shew 20 persons round as one—indeed it is easier for the competition of wits elucidates much which would be untold to a single listener. Moreover the managers have not the time to take round a large number of single individuals. I would suggest that commissioners of divisions might organize visiting parties, arranging suitable dates in the seasons of active farming operations and giving due notice to the farms. Visitors who know English can discover in the annual programmes of work and reports what they should see : for those who do not know English there is a considerable number of vernacular leaflets on various subjects available at the farms.

Agricultural-Co-operative Conference.

26. A successful agricultural and co-operative conference, which was attended by some 300 persons, was held at Lyallpur on November 4th—6th 1912. The proceedings of the conference have been published separately. The most important advantage of a conference of this sort is the opportunity it gives for a large number of people—officials no less than landowners—to see and discuss on the spot the work being carried out on our farms. The demonstrations of implements aroused much interest at the time, and the conversation of those who attended the conference, when I have met them subsequently on my tours, has shewn that the interest was in many cases permanent.

The conference was also intended to emphasize the importance of co-operation in agriculture. The department of agriculture and the department which guides the co-operative societies must work hand in hand, and each has most important work to do in the improvement of agriculture. But I would strongly deprecate any confusion of their spheres of work. It is for the agricultural department to demonstrate implements and methods of cultivation, and this we must do through individual cultivators, selected because they are good cultivators not because they are good co-operators ; it is also for the Agricultural Department to multiply seed under our own supervision and to choose our seed growers because they are likely to grow the seed according to our directions in the best way, not because they are presidents of co-operative unions. Then the co-operative societies take up the work and provide the capital for stocking and selling or hiring out proved implements and for buying up seed and distributing it to their members by sale. The link between the two spheres of work will be supplied by the selection of members of co-operative societies to be members of agricultural associations and by co-operation between the registrar of co-operative credit societies and the director of agriculture. Unity of purpose is wanted not confusion of organization. Other reasons apart, any unification of agricultural associations with co-operative societies would exclude from them the great bulk of the Hindu and Sikh cultivators, who are generally the better farmers, but have not taken up co-operation with the same enthusiasm as the Muhammadan peasant.

Well-boring.

27. The well boring is the least successful branch of our work. The rules for the control of well-borers are full and explicit, but, as the deputy director remarks in paragraph 13 of appendix I are hardly known by the deputy commissioners and tahsildars under whom the borers work. The deputy commissioner must be left to give orders as to the villages in which the borers are to work and to take such measures as are necessary to secure that people who ask for their wells to be bored provide the necessary labour (12 men) regularly and continuously, and, when the boring is successful, supply bullocks to work the well and clear out a cavity in the water bearing sand. But in many districts the borers are left to themselves without programme or labour—in one district the deputy commissioner advanced a small sum of district board money to the borer, who was expected to find labour for himself—they are not used for agricultural wells but for rest-house wells, for municipal wells and even for polo ground wells. Rules 15, 16 and 17 are seldom observed. The men get only Rs. 15 a month and

neither immaculate honesty nor untiring energy can be expected for this, and naturally without supervision idleness and probably petty extortion are common. We have three supervisors, but they are not men of authority and can supervise the work from the professional side only. The boring work is, however, of great value to the people, and I have seen many wells the owners of which are well pleased with the work done. When our agricultural engineer is appointed there is sure to be an immediate move forward.

Assessment of revenue on land improved by modern implements.

28. During the past year the question of the assessment of land permanently improved by the use of western implements of cultivation has come to the fore. In the Lyallpur district four squares of land, which about four years ago was, as noted by the deputy director, "in shocking condition, badly cultivated infested with weeds and crops miserable," had in the interval, on the deputy director's advice, been cultivated with western implements and so improved that it was placed this year in the first class for assessment purposes. I wrote to the settlement officer on the subject, and the land was taken from the 1st and put in the 2nd class. Moreover, in the Jullundur district where the department is now trying hard to popularize soil inverting ploughs part of the conservatism which has to be broken down is due to a fear—often openly expressed—that land improved by the use of English ploughs and harrows will be penalized with an increased assessment in the settlement which is about to start. The policy of the government of India appears to be that improvements due to the use of such implements should be exempted from assessment so as "to allow the improving landholder to recover from the net profits of the improvements within the term of exemption the capital cost of his improvement with interest." I have accordingly proposed that lands improved in this way should be exempt from increased assessment for a term of five years.

Miscellaneous proposals in connection with the colonization of the Montgomery bar.

29. Three matters of the first importance have been dealt with in connection with the colonization of the government lands commanded by the canals of the triple project. The proposals which I sent up were :—

(1) That in all lands on the lower Bari Doab canal only American cotton from approved seed should be cultivated. This would have secured the production of a large amount of long staple cotton free of admixture.

The government of India refused to sanction this.

(2) That a block of 50,000 acres favourably situated as to irrigation facilities and means of communication should be marked off as available for cane growing for one or more central factories. The land would be allotted to cultivators—whether peasants or capitalists—like any other land, but subject to the following conditions:—

(1) That if a factory approved by government is established, not less than 1/5th of each holding shall be placed under cane every year.

(2) That the cane shall not be sold for the manufacture of white or crystallized sugar except to the factory.

(3) That the price to be paid for the cane shall be fixed annually by agreement between the growers and the factory owners.

In this way 10,000 acres of cane would be grown annually within an area of 78 square miles, and this would be enough to supply one large or several small central factories. The factory owners would through the prohibition of outside sale be secured from competition by other sugar-makers, while the growers by the reservation to them of power to manufacture gur from their cane would be able to insist on as good a return to themselves as they could obtain by making gur. I do not think we should go further in limiting the price which the owners may ask.

The financial commissioners have accepted this proposal.

(3) That in all new villages an adequate area (probably 20 per cent. of the cultivated area) should be set apart as irrigated grazing grounds to enable the settlers to rear up their young stock as bullocks and so meet locally part of the demand for plough cattle which the breeding tracts of the province are, as proved by the rapidly rising prices, now failing to meet. Agricultural improvement depends largely on the more general use of heavy bullocks, which can draw soil inverting ploughs and other implements necessary to increase the productiveness of the soil, and it is essential that the supply of such bullocks should in some way be increased. With good grazing too much less land would have to be put under unrenumerative fodder crops than at present. This question is still pending with the financial commissioners who do not, however, regard my proposals with favour. In a slightly different form the same problem awaits us in those old districts of the province where little grazing ground remains and the young cattle are sold off.

I am sorry this report is so long; but the subjects to be dealt with are very various, and it is well that stock should be taken thoroughly once a year.

W. S. HAMILTON,

Director of Agriculture and Industries, Punjab.

15*th September* 1913.

APPENDIX I.

REPORT ON DISTRICT WORK BY THE DEPUTY DIRECTOR OF AGRICULTURE.

1. *Agricultural machinery.*—The introduction and demonstration of labour-saving machinery has again occupied much time this year.

2. *Ploughs.*—The improved Meston plough by Ransomes, Sims and Jefferies is giving general satisfaction and is very popular. It is cheap and also of light draught. Ransomes' Steel Bar plough is very useful for deep cultivation and is capable of tackling stiff lands and is also very suitable for reclaiming lands infested with grasses. In the Hoshiarpur district it has been tried for deep cultivation in the Sirwal sugarcane growing tract and was generally liked by the people. It may be noted here that Messrs. Octavius Steel and Co., Calcutta, the representatives of Messrs. Ransomes, Sims and Jefferies, have opened an implement depôt at Lyallpur, and intend to start sub-agencies in some districts for stocking ploughs, etc.

3. *Harrows.*—Our last year's experience of harrowing the young wheat crop on the Gurdaspur Farm encouraged us to try harrowing on an extensive scale. Consequently 48 chain harrows were distributed to land-owners in six districts for trial and demonstration. It is to be regretted that these harrows were not given a thorough trial by the zamindars except in two districts, the reason being that the practice was quite strange to them and they could not take it up with any confidence in the first year. Moreover, owing to the early cessation of the monsoon, there were little barani sowings in some of the districts.

4. *Bullock hoe.*—The demonstration of sowing cotton and maize in lines so as to allow of after cultivation between rows was carried on in many places in the Lyallpur colony with good results. The Gujrat hoes mentioned in last year's report were issued as implements of inter-culture. They are still under trial.

5. *Reaping machines.*—Our mistri visited 67 machines before harvest, and our staff visited all the machines in the Lyallpur and Chunian Colonies during the harvesting season. Only a few were not used for various reasons, the chief among them being the same as mentioned in the last year's report. But wherever they have been used, they were used with good results and gave great satisfaction. Some zamindars cut as much as 8 to 10 acres per day. It is to be regretted that there is no practice of hiring these machines, as much more work would have been done by these machines during the harvesting seasons to the benefit of both the owners and hirers. The owners are afraid of their machines being spoiled and ill-used. Messrs. Volkart Brothers, Lyallpur, who still continue the sale of reapers, have sold seven new machines this year in the colony.

6. *Steam threshing.*—Mr. Armes, the representative of Messrs. Ransomes, Sims and Jefferies, came out to India in the winter, and a demonstration of a steam thresher was given at the Lyallpur cattle fair with last year's wheat, which had been stacked for this purpose. It was proposed to give extensive demonstration in the colony during the harvesting season with the two machines; but some of the parts of the old Gurdaspur machine did not arrive in time, and it was not given any trial, but the improved machine, which was received at Lyallpur last year, was given a good trial. This machine worked satisfactorily, made good bhusa and threshed out the grain clean and unbroken, but the output of clean dressed grain has been below expectations, especially when the crop was at all coarse or long in the straw. An alteration in the feeding drum, it is hoped, will rectify this fault. The value of steam threshing is sure to be recognised in a year like this when much damage is done owing to untimely rain during the threshing season.

7. *Demonstration farms and outside demonstrations.*—The interesting feature of the year's work was the starting of three demonstration plots in the Jullundur district with the object of giving practical demonstrations of the methods of dry farming, recommended by the department, in the zamindars' own fields. Work was taken in hand rather late, but except in Nakodar where the crop failed the demonstrations were a success. These places were much visited by the local zamindars, and here frequent demonstrations of implements were given.

Besides the above, demonstrations of implements were carried out in the following places :—

	District.
Gujrat	Gujrat.
Pakpattan	Montgomery.
Pattoki	Lahore.
Hoshiarpur	Hoshiarpur.
Hissar	Hissar.
Bheni Melan	Gurdaspur.

These demonstrations were very successful and attracted considerable attention.

8. *Agricultural Associations.*—An important feature of the year's work is the starting of Agricultural Associations in the six districts of Jullundur, Hoshiarpur, Gujrat, Gurdaspur, Lyallpur and Montgomery. There were two meetings of each of these associations during the year. At these meetings the half-yearly work is discussed; members give their report of the work of the implements lent to them by the department and other work entrusted to them. The department lent out 48 chain harrows, 6 spring toothed harrows and 94 ploughs for trial to the members of these associations.

9. *Wheat and cotton survey.*—During the year under report a wheat survey of Gujrat, Hoshiarpur and a part of the Lyallpur district was carried out. A cotton survey on similar lines was started in the Lyallpur district.

10. *Seed farms and distribution of seed.*—Cotton and wheat seed farms have been started in Lyallpur, Jullundur, Hoshiarpur and Gurdaspur districts and in the Jhelum colony. Some wheat seed of types 13 and 14 was also distributed in the Jullundur, Hoshiarpur and Gurdaspur districts and the results have been promising.

11. *Sargodha seed farm.*—The farm has been taken over from the Deputy Commissioner only this kharif to be used as a seed farm for the propagation of suitable varieties of cotton and wheat for the Jhelum colony.

12. *Staff.*—Among the agricultural assistants on my staff employed in the district work Q. Samiullah and Bhai Sucha Singh have done good work.

13. *Well-boring.*—Eighteen plants have been working in 11 districts of the province. As reported last year the work is split up into three circles, each in charge of a supervisor as follows :—

Rewari	Gurgaon. Karnal. Rohtak.
Ludhiana	Amballa. Ludhiana. Ferozepore. Montgomery.
Jullundur	Hoshiarpur. Jullundur. Sialkot. Gujrat.

During the year 216 wells were bored and 14 trial borings made. The water-supply was increased in 116 wells, and 11 out of 14 trial borings were successful. The results in the Rewari Circle have been best, showing an average success of 66·32 per cent.

The causes of failure are almost the same as last year. In many cases water would probably have been increased, had the work been continued, but the work was stopped, as the owners were not willing to go to a good depth. Another cause of failure has been the employment of borers by the district officers, under whom they have been placed, in most unsuitable tracts, where there were small chances of success, as our plants are not suitable for boring in rock or going much deeper than 100 feet. For instance, the Hoshiarpur borer has mostly been employed on the district board wells in the hilly tracts of the district.

It is to be regretted that the district staff with few exceptions fails to control the well-boring operations. The rules for the control of borers seem hardly ever to be read or followed.

Appended is a statement showing the districts where work has been carried out.

Well-borings during 1912-13.

No.	Name of district.	EXISITING AND PROPOSED WELLS.		REMARKS.
		Number of wells.	Successful.	
1	Gurgaon	40	27	16" trial boring.
2	Rohtak	28	24	
3	Karnal	27	12	
4	Jullundur	30	14	
5	Hoshiarpur	8	2	
6	Gurdaspur	6	1	
7	Gujrat	11	2	16" trial boring.
8	Rawalpindi	1	1	
9	Shahpur	8	5	5" trial boring.
10	Sialkot	11	10	
11	Ludhiana	28	16	
12	Ferozepore	12	6	3" trial boring.
13	Montgomery	6	4	
14	Amballa	14	3	1" trial boring.
	Total	230	127	

M. FATEH-UD-DIN,

Offg. Deputy Director of Agriculture, Punjab.

APPENDIX II.

REPORT OF THE PRINCIPAL OF THE AGRICULTURAL COLLEGE.

THE fourth session of the college commenced on the 20th July 1912 with a diploma class of 18, a second year class of 17 and a first year class of 26 students, making 61 students in all who were candidates for the college diploma. In addition to these, there has been given during the year a vernacular course in practical agriculture of six months' duration to a class of 13. A similar course of two months' duration, dealing chiefly with the use of improved varieties of farm implements, was held for 11 military overseers. A five weeks' course of farm tuition was given to five Assistant Commissioners, and a special course of practical agricultural chemistry and botany to one casual student—making 90 students in all

The religion of the Indian students attending the college was as follows :—

Hindus	36
Sikhs	20
Muhammadans	29
Total	85

2. *Diploma Examination.*—The second diploma examination commenced on the 21st April 1913 and 17 candidates presented themselves for examination : 8 were successful. A change has this year been effected in opening the examination subjects of physics, mathematics, land revenue and surveying to first and second year students and so lightening the load in the final examination. This change also enables me to exercise a more effective control over the promotion of students to a higher class than was hitherto possible. The standard of the examination was about the same as last year, but the candidates were on the whole not so good.

3. The students of the second year are particularly backward, and reference may be made to my report for the year 1911, in which I drew attention to the falling off of recruitment for the College. The first year students are on the whole better, but all show a marked weakness in general elementary education. I have called attention to this point in my annual reports for 1911 and 1912, and my views are confirmed by the board of examiners. The result is that the students experience considerable difficulty in assimilating the course during the first year and never probably regain the ground so lost. It would appear that there is a gap between the standard of education in this college and that possessed by the holders of matriculation certificates, the qualification fixed for our entrance. The visiting examiners and my colleagues on the college staff are of the opinion that either the standard now followed should be lowered or the standard of admission raised and the course lengthened to one of four years. The matter appears to me one of such vital importance and either of these changes so far-reaching in their effects that I have asked for the subject of agricultural education to be discussed by this year's board of agriculture and a full investigation made of the educational policy of the past five years.

4. *Agricultural Engineering course.*—The course in agricultural engineering has this year been omitted, as no teacher was available.

5. *Short vernacular course for sons of zamindars.*—A short course of 5½ months was given for the first time this session. The class was divided into two terms. One from the 1st of October to the middle of December in which the students studied tillage operations and rabi sowing and the second from the beginning of February to the end of April, when harvesting operations and cotton and sugarcane sowing are in progress.

The course is entirely practical, short lectures being given in the field. These students also attended classes in botany, veterinary science and entomology and were from time to time taken for short excursions in the neighbourhood of Lyallpur. On the whole the course seems to be modelled on the right lines, though we shall require one or two years' further experience before definitely fixing the length of the course or framing a detailed syllabus and time table.

6. It is regrettable to report that at the commencement of last session difficulty was experienced in obtaining the attendance of students, for many of these did not put in an appearance until three weeks after the commencement of the term This difficulty was experienced in the two previous sessions, and this year two weeks of the new session have elapsed without a single student of the first year class appearing. My interpretation of this indifference is that the trouble entailed in obtaining our diploma is not adequately recompensed in the salaries they can command after leaving us, and that educational qualifications fitting them for congenial employment can be obtained elsewhere in the province at a less expenditure of effort and possibly money also.

7. *Expenditure.*—The working expenses of the college during the past year have been as follows :—

	Rs.
Pay of officers and establishment	54,353
Travelling allowance	7,168
Contingencies	36,756
Total ...	98,277

The expenditure for the past four years from the opening of the college has been as follows :—

	Rs.
1909-10	95,240
1910-11	90,564
1911-12	92,517
1912-13	98,277

Income—

	Rs.
1909-10	764
1910-11	3,818
1911-12	8,290
1912-13	11,739

This figure of Rs 98,277 includes the pay of officers and staff and covers the expenditure attendant on research work as well as teaching. It must however be borne in mind that the greater portion of each expert's time has during these past five years been devoted to the educational side of the college work. Consequently the bulk of the expenditure should be debited to this.

8. *College buildings and grounds, etc.*—A scheme for improving the water-supply of the college has been sanctioned at an estimated cost of Rs. 6,493 and for the addition of a dairy building at a cost of Rs. 10,416. These will be complete before the end of the present year. The museum has also been extended by throwing in another room at a cost of Rs. 1,000. Administrative sanction has been received to the construction of quarters for the assistant professors and the research assistants at a cost of Rs. 19,700.

The resources of the workshop are not being developed to anything like the extent they might be owing to the lack of skilled supervision ; and the need for an Agricultural Engineer in charge is keenly felt both here and in the college curriculum. The college grounds have improved but slowly. In some parts, where we have plenty of water, trees and shrubs grow well, but on the whole we have been very short of water. This is to be rectified during the forthcoming year by the extension of a special water distributary to the agricultural station. A large portion of these grounds is devoted to playing fields and athletic grounds for the students.

9. *Hostel.*—The hostel was extended in July 1912 and now provides accommodation to 85 students. The hostel itself has been satisfactorily managed during the year by the Assistant Professor of Botany, and the health of the students has on the whole been good and there has been no case of any serious disorder.

10. *The Library.*—The library has had some 350 volumes added to it during the year and now consists of 8,280 volumes.

11. *Entrance Scholarship Examination.*—An entrance scholarship examination was held on the 8th May 1913. 25 nomination rolls were received, but only 11 candidates presented themselves for examination as follows :—

2 from Amballa division.
5 from Rawalpindi division.
1 from Multan division.
Nil from Lahore division.
3 from Jullundur division.

Of these 7 were recommended for the government scholarship of Rs. 10 per mensem each. In addition 15 applications were received from candidates for entrance as fee-paying students—

11 from Punjab.
1 from a Native State.
2 from North-West Frontier Province.
1 from Rajputana.

I held a personal oral examination of these on the 19th, and 7 of the students presented themselves. I was able to admit 5. The educational standard of these candidates is much too low for what we require for our diploma course.

12. *Clubs, societies, etc.*—The College Athletic Club and College Science Society have not shown the healthy growth of previous years. This I attribute to a lack of enthusiasm on the part of the assistant staff. This will be rectified in the forthcoming year. The discipline has been good both in the college class rooms and in the hostel, and the behaviour of the students has with two exceptions been satisfactory.

13. *Staff.*—Several changes have occurred in the college staff during the year. Mr. Roberts, Professor of Agriculture, officiated as Principal of the College and Mr. Annett, Supernumerary Chemist, as Agricultural Chemist, while I was on leave last summer. The Assistant Professor of Botany, Mr. Ram Gopal, was appointed Director of Agriculture to the Kashmir State and left us on the 22nd April 1913. He was replaced by Lala Jai Chand of the Dyal Singh College. Mr. Ram Gopal has done useful work while in the Punjab agricultural department and we shall miss his services.

The Demonstrator in Chemistry, Lala Ramji Narain, resigned his appointment on January 1st, 1913, to accept the Kapurthala research scholarship in chemistry of the Punjab University and is working on "Sugarcane sugars" under my direction in the college laboratories. This post was filled by Ishar Lal Tapidas Mehta of the Bombay University but is again vacant.

J. H. BARNES,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX III.

Report of the Agricultural Chemist.

1. *Staff.*—Mr. H. E. Annett was in charge of the section from April 15th, 1912, to November 15th, 1912, while I was on six months' combined leave. One research assistant, Tarak Nath Dass, resigned on 15th April 1913. The vacancy has not yet been filled up in the absence of a suitable candidate. Barkat Ali still remains at Pusa under training with the Imperial Bacteriologist.

2. *Provincial chemical work.—Analyses for the Department of Agriculture.*—During the course of the year 183 samples have been analysed for the department and for private persons. These samples consisted of—

Soils,
Waters,
Manures,
Chemicals,
Milk,
Beet roots,
Gurs
Cane samples,
Saccharine Juars, and
Other materials.

3. *Investigations.—Sugarcane in Gurdaspur district.*—The analytical survey of the canes in the Batala and Gurdaspur tahsils of this district was continued during the season 1912-13, some 76 samples of cane and 36 samples of gur and shakar being analysed. The average sucrose content of cane juice in the Gurdaspur district this year was 16·16 per cent with an invert sugar content of 0·71 per cent as compared with an average of 16 3 per cent sucrose and ·65 per cent glucose last year. The cane this year was rather better, the averages having been lowered by a spell of frost in January.

Eighteen varieties of canes grown on the Gurdaspur Farm were examined fortnightly to watch the effect of any marked temperature changes and the determination of the ripening period of the various varieties. The results obtained have enabled us to divide the canes into three classes—

(*a*) Frost-resistant canes.
(*b*) Semi-resistant to frost.
(*c*) Delicate canes.

This is an important differentiation in the Punjab, where the canes will almost certainly be subject to one or more attacks of frost. The effect of frost on the delicate and semi-resistant canes is an immediate or retarded fall in the sucrose of the juice accompanied by a corresponding increase in invert sugars. In all cases this year the canes were able to recover, the period of recovery extending over several weeks in some cases. This retardation of ripening is a disadvantage since it means a suspension of boiling operations while the cane recovers. If the frost is severe the cane will be damaged beyond recovery.

The ripening curves of these varieties have also been worked out for the season.

4. In addition to the above, 43 samples of cane from the Lyallpur Farm were analysed and showed an average juice composition of 16·28 per cent sucrose and 0·2 per cent invert sugar, or about as good as the average Gurdaspur canes.

5. The results of some 68 analyses confirmed the results of other observers that the sugar contents of the juice varies from cane to cane in the same stool and that the sucrose content is invariably higher in the lower part of the stem.

6. The experiments on the effect of storing canes have not been conclusive this season, as the polarimeter required for these analyses was not returned from repairs in Europe until the cane season was practically over and the cane ripe.

7. Thirty-six samples of gurs derived from the above varieties of cane were analysed and gave an average composition of sucrose 68·4 per cent, invert sugar 12·2 per cent, the best containing 76 per cent sucrose.

The whole of these results in detail with the analytical data will be published in a separate special report which should be compared with the sugar progress report issued last year.

8. *Saccharine juar* —Some 25 samples of saccharine juar were analysed by Mr. Annett and showed an average composition of less than 10·8 per cent sucrose and not more than 6·5 per cent glucose. Gur prepared from the juice of this juar at Lyallpur contains 57·9 per cent sucrose and 12·4 per cent invert sugar. As a source of sugar, this crop is not promising, but might prove useful in other directions.

9. *Preservation of stored wheat.*—Some experiments have been in progress during the last two years on the preservation of wheat and gram against the attacks of weevil. Our results have not yet reached a final stage, but the use of carbon dioxide seems promising. These results will be published later after some further work in collaboration with the Imperial Entomologist.

10. *Lateral movement of reh salts.*—Positive evidence has been obtained of the lateral movement of salts in solution in the upper layers of alkali soils, and a new explanation has been found for the growth and extension of alkali patches. The experiments on which these results are based will be published separately.

11. *Canal seepage and the rise of water level in the Chenab colony.*—The experiments devised to investigate the cause of this rise of well level tend to show that the rise of well level is not entirely due to seepage from the canals, and though the phenomenon invariably accompanies irrigation, it cannot be stopped by lining the canals. I hope to be able to give a detailed report on this very important matter towards the beginning of 1914.

12. *Solar radiation* —A systematic series of records of the energy value of the sun's rays have been taken at Lyallpur for upwards of a year and will be published separately. The effective depth to which the sun's heat penetrates the light soils of Lyallpur appears to vary from 15—30 feet. These records are not yet in a sufficiently complete state for publication.

13. *Reh.*—Several of the above-mentioned experiments have been carried out in connection with this subject. Our results will take practical form towards the end of 1913 in an experimental reclamation farm at Narwala,—the method to be tried being sub-soil drainage combined with irrigation.

14. *Tours.*—During the year the Agricultural Chemist and the staff travelled 4,642 miles by rail and 332 by road and visited the following districts :—

Lyallpur, Lahore, Pusa, Rawalpindi, Montgomery, Gurdaspur, Ludhiana, Amritsar, and Gujranwala.

While on leave last summer, I was placed on special duty in Hungary and Egypt to study the manufacture of sugar from beet and from sugarcane in these two countries. I collected a considerable amount of valuable data on the subject which I hope to submit in the form of a report on my tour. The report has been held back owing to the press of work at Lyallpur since my return. I have imported a new cane from Egypt which promises to do well in the province. Its original parents were a thin Indian cane and a thick Island cane crossed in Java. It was thrown out there as subject to disease in the moist hot climate of that island, but being imported with many other canes by M. Naus into Egypt for experimental purposes it was found to be the cane best suited to the dry climate prevailing there. Under native cultivation in Egypt this cane yields an average of 17½ tons per acre and is particularly immune to disease there. If we can secure it against insect pests in the Punjab it should have a future before it in this province. At the present time the seed sets are doing well at Lyallpur.

J. H. BARNES,

Agricultural Chemist, Punjab, Lyallpur.

APPENDIX IV.

Report of the Economic Botanist, 1912-13.

1. *Prefatory.*—Much the greater part of my time has been occupied during the past year in work connected with the teaching of the various college courses. Unfortunately a change of assistant professor which took place lately makes this state of affairs likely to continue for some time yet.

2. *Wheats.*—Small plots of the Punjab classified types of wheat have been grown in order to preserve a supply of pure seeds of these. Some 29 new types of the Punjab

wheats have now been found. They have been grown on experimental plots ranging from $\frac{1}{32}$ to $\frac{1}{4}$ of an acre areas and will be further tested in due course. The outturns from several of these are very good indeed.

A large number of artificial crosses in their 3rd generation were dealt with in the past harvest. A considerable number of these that appeared to be fixed types and suitable will be resown and further tested.

3. *Barleys*.—Samples of barleys were collected from the chief barley growing districts of the Punjab during last summer and have been grown here. A special report on this work has been sent to the Director.

The six-rowed barley *Hordeum Vulgare* variety *Hexastichon* is by far the most common barley in the Punjab. Fortunately for brewing work, the varieties of barley met with were not found growing mixed together. Samples of these barleys are being compared as regards their agricultural, brewing and commercial qualities.

4. *Cottons—General*.—The land on which the cottons were sown this year was extremely poor in many parts.

5. *Acclimatised American cottons*.—On plots of average quality of land the outturns of unginned cotton (*kapas*) were from 12 maunds per acre upwards. In one plot of $\frac{1}{2}$ acre area the outturn from selection No. 275 was 19 maunds 24 seers per acre, while in a plot of exceptionally good land of about $\frac{1}{8}$ acre area the outturn from a lately selected plant *viz*. No. 280, was 21 maunds and 32 seers per acre. The outturns from the poor plots were in many cases miserably poor. Samples of lint from these cottons were sent as usual for valuation to the British Cotton Growing Association, Manchester, to Messrs Tata and Sons, Bombay, and to the Imperial Cotton Specialist, India. Owing to having to send the cottons to the British Cotton Growing Association through the Imperial Institute this year and the reply having to return by that channel, the report of the above Association is not yet to hand. Messrs. Tata and Sons value our acclimatised American Selection No. 280 F. at Rs. 410 per candy (784 lbs.) and remark that this is an excellent cotton and will spin 50 s. This cotton has a fair percentage of fibre to *kapas*, well covered seed, and gave us our highest yield, but on exceptionally good land. It promises exceedingly well, however, and has been handed over to the Professor of Agriculture for testing on a large scale. Selections Nos. 282—a new selection—and 72 F were valued at Rs. 400 per candy; No. 111 at Rs. 360 and quite a number of other selections from that figure downwards. Unfortunately No. 246, which is one of our very good selections, was on an extremely poor plot and its lint was so miserable that it was not sent for valuation this year. A sample of ordinary unselected acclimatised American cotton as grown by the zamindars around Lyallpur was valued by Messrs. Tata and Sons along with our selections and was priced at Rs. 315 per candy. Messrs. Tata and Sons in recommending our selected cottons to be distributed to selected farmers remark "..................the result should be satisfactory and the question of British grown stapled cottons will to a certain extent be solved". It is satisfactory in this connection to be able to record that selected cottons handed over from the botanical to the agricultural section in previous years have given higher yields of *kapas* per acre than unselected acclimatised American cotton. Also that a firm offered Rs. 12-8-0 per maund of *kapas* for one of these selections while they were only offering Rs. 10 per maund for unselected cottons.

6. *Collection of Punjab and North West Frontier Province cottons*.—Members of my staff toured during last cotton season in various places to discover which types of cottons preponderate in the mixtures at present grown in a locality. This information will help us to decide which of our pure types will be likely to do well in a locality.

7. *Miscellaneous experiments on cottons*.—The root rot disease in cotton which causes so much damage to the crop in the Punjab, and the cause of which has been a puzzle to all, has now been shown to be due to a nematode worm Tylenchus Sp.

8. Various other experiments are being carried out in connection with cottons, and the results of these will come out in due course.

9. *Date palms*.—A special report on the past three years' work on date palms and proposals for future work has been sent to the Director of Agriculture with my letter No. 213 E.B., dated 19th-23rd April 1913. Of the Arabian trees planted in September 1910, about 50 plants in the Central Jail Multan, 30 in the Taleri Bagh, Muzaffargarh, and 15 at Lyallpur are bearing fruits this year. The fruits are nearly ripe and give promise of being of very good quality. The trees have cost about Re. 1 each landed at Multan, and the experiments show that the death-rate need not be more than the 20 to 30 per cent. allowed by the arabs. Enquiries show that the crop of date fruits of the Punjab is worth not more than 12 lakhs per annum, and that by merely substituting moderately good trees for the inferior female and for male trees, not required if hand pollination is resorted to, and thus raising the value of the fruits to one anna per lb., the value of the crop would be raised to 60 lakhs per annum.

A pamphlet has been written containing instructions for those who wish to take up date improvement.

10. *Miscellaneous*.—Various experiments on minor crops and weeds are being carried out.

Work on gardening has suffered severely for several years for the want of a gardener qualified to carry out my experiements.

D. MILNE,

Economic Botanist, Punjab.

Statement A.—*New types of wheat.*

Type No.	Date of			Outturn per acre.				Condition of the standing crop.						Total area in acres.
				Grain.		Straw.		Good.		Medium.		Poor.		
	Sowing.	Earing.	Ripening.	Maunds.	Seers.	Maunds.	Seers.	Area in acres.	Height in feet.	Area in acres.	Height in feet.	Area in acres.	Height in feet.	
Standard (IX) ...	26th October 1912.	28th February 1913.	29th April 1913.	36	0	38	0	...	...	$\frac{1}{32}$	5	...	—	$\frac{1}{32}$
XIX H. ...	26th October 1912.	27th February 1913.	20th April 1913.	29	24	87	8	...	...	$\frac{7}{256}$	$5\frac{1}{4}$	$\frac{1}{256}$	$4\frac{1}{4}$	$\frac{1}{32}$
XIX F. ...	26th October 1912.	26th February 1913.	20th April 1913.	30	16	88	0	$\frac{1}{96}$	5	$\frac{1}{96}$	$4\frac{1}{2}$	$\frac{1}{96}$	4	$\frac{1}{32}$
XIX E. ...	26th October 1912.	16th February 1913.	21st April 1913.	26	16	64	0	$\frac{1}{128}$	5	$\frac{1}{64}$	$4\frac{1}{2}$	$\frac{1}{128}$	4	$\frac{1}{32}$
XIX C. ...	26th October 1912.	15th February 1913.	30th April 1913.	34	16	92	0	$\frac{1}{128}$	$5\frac{1}{4}$	$\frac{7}{384}$	5	$\frac{1}{192}$	4	$\frac{1}{32}$
XXIV A. ...	26th October 1912.	16th February 1913.	21st April 1913.	33	16	79	16	$\frac{5}{192}$	$5\frac{1}{4}$	$\frac{1}{384}$	5	$\frac{1}{384}$	$4\frac{1}{2}$	$\frac{1}{32}$
XVIII A. ...	26th October 1912.	16th February 1913.	19th April 1913.	29	24	67	8	$\frac{1}{64}$	$4\frac{3}{4}$	...	...	$\frac{1}{64}$	$3\frac{1}{2}$	$\frac{1}{32}$
XX A. ...	26th October 1912.	16th February 1913.	19th April 1913.	22	11	55	2	$\frac{}{32}$	4	$\frac{3}{32}$	$3\frac{1}{2}$	...	...	$\frac{3}{16}$
Standard (IX) ...	26th October 1912.	27th February 1913.	29th April 1913.	28	32	70	16	$\frac{1}{48}$	5	$\frac{1}{144}$	$4\frac{1}{2}$	$\frac{1}{288}$	4	$\frac{1}{32}$
XXV A. ...	26th October 1912.	16th February 1913.	22nd April 1913.	21	8	65	8	...	...	$\frac{1}{32}$	5	...	...	$\frac{1}{32}$
XXV C. ...	26th October 1912.	20th February 1913.	19th April 1919.	32	0	49	24	$\frac{1}{32}$	4	...	...	...	...	$\frac{1}{32}$
VIII B. ...	26th October 1912.	13th February 1913.	19th April 1913.	32	0	73	24	$\frac{1}{32}$	4	...	...	...	...	$\frac{1}{32}$
XX B. ...	26th October 1912.	16th February 1913.	20th April 1913.	30	0	68	28	$\frac{1}{4}$	4	...	...	...	...	$\frac{1}{4}$
XXIV B. ...	26th October 1912.	17th February 1813.	19th April 1913.	29	32	68	16	$\frac{1}{4}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{4}$
Standard (IX) ...	26th October 1913.	28th February 1913.	29th April 1913.	39	8	94	16	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$
XVII A. ...	26th October 1912.	13th February 1913.	20th April 1913.	26	36	60	0	$\frac{1}{4}$	5	...	...	...	...	$\frac{1}{4}$
XVII B. ...	26th October 1912.	14th February 1913.	19th April 1913.	26	12	64	36	$\frac{1}{8}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{8}$
XXIV D. ...	26th October 1912.	16th February 1913.	19th April 1913.	24	32	78	24	$\frac{1}{8}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{8}$
Standard (IX) ...	26th October 1912.	28th February 1913.	29th April 1913.	40	32	102	16	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$
XIX D. ...	26th October 1912.	12th February 1913.	21st April 1913.	25	4	59	28	$\frac{3}{128}$	$4\frac{3}{4}$	$\frac{1}{128}$	4	...	...	$\frac{1}{32}$
XXIII A. ...	26th October 1912.	20th February 1913.	24th April 1913.	21	0	55	38	$\frac{1}{8}$	$4\frac{1}{2}$	$\frac{1}{8}$	4	...	...	$\frac{1}{4}$
Standard (IX) ...	26th October 1912.	22nd February 1913.	29th April 1913.	13	32	23	8	...	...	...	...	$\frac{1}{32}$	4	$\frac{1}{32}$
Standard (IX) ...	26th October 1912.	28th February 1913.	29th April 1913.	36	32	131	8	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$
VIII A. ...	26th October 1912.	26th February 1913.	26th April 1913.	34	20	92	0	$\frac{1}{4}$	5	...	...	...	...	$\frac{1}{4}$
IX B. ...	26th October 1912.	7th March 1913.	25th April 1913.	26	8	96	8	$\frac{1}{8}$	$4\frac{3}{4}$	...	...	...	...	$\frac{1}{8}$
Standard (IX) ...	26th October 1912.	1st March 1913.	29th April 1913.	31	8	88	0	$\frac{1}{32}$	$5\frac{1}{2}$	...	...	...	...	$\frac{1}{32}$
IX A. ...	26th October 1912.	1st March 1913.	26th April 1913.	25	6	69	18	$\frac{1}{8}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{8}$
IX C. ...	26th October 1912.	16th February 1913.	26th April 1913.	26	24	62	32	$\frac{1}{8}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{8}$
Standard (IX) ...	26th October 1912.	28th February 1913.	29th April 1913.	34	8	93	32	$\frac{1}{32}$	5	...	...	...	...	$\frac{1}{32}$
XXIV C. ...	26th October 1912.	16th February 1913.	26th April 1913.	24	32	83	8	$\frac{1}{32}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{32}$
XX C. ...	26th October 1912.	16th February 1913.	24th April 1913.	32	32	103	8	$\frac{1}{32}$	$4\frac{3}{4}$	...	...	...	...	$\frac{1}{32}$
XX D. ...	26th October 1912.	12th February 1913.	21st April 1913.	22	16	90	16	$\frac{1}{32}$	$4\frac{1}{4}$	...	...	...	...	$\frac{1}{32}$
XX E. ...	26th October 1912.	16th February 1913.	29th April 1913.	25	8	86	32	$\frac{1}{32}$	4	...	...	...	...	$\frac{1}{32}$
Standard (IX) ...	26th October 1912.	28th February 1913.	29th April 1913.	30	16	95	8	$\frac{1}{32}$	$4\frac{3}{4}$	...	...	...	...	$\frac{1}{32}$
XIX G. ...	26th October 1912.	16th February 1913.	26th April 1913.	30	16	80	0	$\frac{1}{32}$	4	...	...	...	...	$\frac{1}{32}$
XIX A. ...	26th October 1912.	26th February 1913.	23rd April 1913.	30	0	74	0	$\frac{1}{32}$	$4\frac{1}{2}$	...	...	...	...	$\frac{1}{32}$
XIX B. ...	26th October 1912.	18th February 1913.	23rd April 1913.	34	16	98	16	$\frac{1}{32}$	$4\frac{3}{4}$	...	...	...	...	$\frac{1}{32}$
XXV B. ...	26th October 1912.	16th February 1913.	20th April 1913.	29	12	68	28	$\frac{1}{48}$	$4\frac{1}{2}$	$\frac{1}{46}$	4	$\frac{1}{48}$	$3\frac{1}{2}$	$\frac{1}{16}$

Summary of E. B.'s remarks.

Germination regular in all cases, except in $\left\{\begin{array}{l}\text{XIX H,}\\ \text{XXV A,}\\ \text{XXV C,}\end{array}\right\}$ where it was thin; tillering good or very good,

except in $\left\{\begin{array}{l}\text{XXV A,}\\ \text{XXV C,}\\ \text{XVII B,}\\ \text{XXIV D,}\\ \text{XIX D,}\\ \text{XIX A,}\\ \text{XIX B,}\end{array}\right\}$ where it was fair: all badly rusted, except $\left\{\begin{array}{l}\text{XIX H,}\\ \text{VIII A,}\\ \text{IX B,}\\ \text{IX A,}\\ \text{XXIV C,}\\ \text{XX E,}\end{array}\right\}$ which were slightly

rusted $\left\{\begin{array}{l}\frac{3}{4}\text{ of XXIV, B,}\\ \frac{1}{20}\text{ of XVII A,}\\ \frac{1}{10}\text{ of XVII B,}\\ \frac{1}{16}\text{ of XXIV D,}\\ \frac{1}{4}\text{ of IX A,}\\ \frac{1}{32}\text{ of XXIV C,}\end{array}\right\}$ lodged: $\left\{\begin{array}{l}\frac{1}{4}\text{ of XVIII A}\\ \frac{1}{4}\text{ of XX A}\end{array}\right\}$ was attacked by white ants.

APPENDIX V.

Report of the Assistant Professor of Entomology.

1. *Prefatory.*—The post of the Teaching and Research Assistant in Entomology has remained vacant throughout the year. I regret to say that the absence of a properly trained assistant has hindered my taking up several important entomological enquiries.

2. Much difficulty is experienced in securing suitable fieldmen and retaining them on the fixed pay of Rs. 12 per mensem.

3. Research and provincial work has been chiefly in three directions :—

(*i*) The moth-borer in sugarcane.

(*ii*) The boll-worm in cotton.

(*iii*) The extension of sericulture.

4. *The moth-borer in young sugarcane.*—A borer commonly known as Garooan or Kiri does serious damage in young canes from March till the end of July. Experiments were started last year to ascertain some method of combating this pest. They show that the regular cutting out of "dead hearts" is very effective in directly checking the growth of these shoot borers. It has been extensively tried this season both at Lyallpur and Gurdaspur and the results prove its usefulness. Zemindars in the Hoshiarpur district and in the Bajwat (Sialkot) are giving it a trial; it appeals to them by its simplicity, and there is hope of cultivators taking to it.

5. Experiments were started last April to test the relative immunity of three principal varieties of canes, *viz.*, Katha, Kahu, and Dhaulu from the attacks of the borer. Results will be available later on.

6. *The bollworm in cotton*.—The cotton crop of 1912 did not suffer from bollworm attacks. Most of the cotton areas had good monsoon rains, which destroyed the early broods of bollworms. In the Jhelum and the Chenab colonies and in the Multan district however the rains failed and the percentage of bollworm attack was pretty high (from 16 to 32 per cent.) during July and the beginning of August.

Rhogas Lefroyi appeared at the Lyallpur Farm in the end of July. It was established in the parasite breeding plot, and in August parasite boxes containing parasitized material were distributed throughout the province. I visited Sargodha, Rohtak, Bhiwani, Hansi, Hissar, Multan and some chaks of the Lyallpur district. Rhogas was obtained from the fields in which parasite boxes were placed, and the bollworm attack was also less in these fields than in the surrounding areas where there was no Rhogas. District officers were requested to multiply parasite boxes for extensive distribution in their districts.

8. *Effect of summer rains upon the prevalence of bollworm.*—During the year several observations have been made showing that rains are an important factor in directly effecting bollworm decrease. The rainfall and bollworm statistics have been gathered for 1912 and 1913 for the Lyallpur farm, and they favour this view—

1912, *June 30th.*		1913, *June 30th.*	
Bollworm attack.	Rainfall.	Bollworm attack.	Rainfall.
14·6	·24	4·5	2·34
1912, *July 30th.*		1913, *20th July,*	
Bollworm attack.	Rainfall.	Bollworm.	Rainfall.
32·4	1·87	·68	4·63

The shaking of cotton plants by hand or with a rope and then thoroughly irrigating the fields will produce very much the same effect as rains do.

9. *Permanent Rhogas-breeding plot.*—The parasite breeding plot was maintained. The growth of the host and the parasite was encouraged till they hibernated during the cold weather. After their period of hibernation was over Rhogas was established during May and June in Bhindi pods. Early bolling was encouraged in ratoon country cottons, and since the beginning of July Rhogas is found in cotton bolls in this plot.

10. At the time of writing bollworm attack is almost *nil* in the farm cottons (Desi ·86 per cent., American ·60 per cent). The parasites are kept going in our parasite breeding plot by artificially increasing their food supply.

11. As soon as there is a demand for parasites from outside we shall be in a position to supply parasite boxes.

12. *Sericulture.*—Sericulture forms an important part of the work. Villages were selected near canal mulberry plantations in the tahsils of Rupar, Jagraon, Kasur, Chunian, Amritsar and Gurdaspur, and in the Bajwat tract of the Sialkot district, where mulberries on the roadside were available. The rearers were usually zamindars who had never known anything of silkworms. Precautions were taken to teach them proper sanitary methods of rearing.

Fifty-one ounces of seed were distributed, 1 ounce apiece. Hatchings commenced at the end of February and continued till the middle of March. Seripositing was completed as late as the 1st week of May in some places. Hot winds from the middle of April had a deleterious effect upon the worms, and this period coincided with the beginning of the spring harvesting season.

Out of 51 ounces 5 ounces were eaten up by rats and the result of 1½ ounces is not available. The remaining 44½ ounces of seed gave us a crop of 7 maunds 32 seers 14 chks. of dry cocoons, and they were sold to Sheikh Ghulam Sadiq of Amritsar for Rs. 759. The prices ranged from Rs. 80 to Rs. 110 per maund, according to the quality of the produce.

The results of the Rupar and Raja Jang rearers are encouraging. Their outturn per ounce of seed was between 13 and 16 seers of dry cocoons and was sold for Rs. 35 to Rs. 45.

13. *General.*—Progress has been made in gaining knowledge of the injurious insects of the province, and remedial measures tried against them whenever opportunities occurred. Special attention has been devoted to the red pumpkin beetle, the epilachna beetles, the surface grasshoppers, the black-headed cricket and katra (Amsacta Moorei Butl.). During June and July time has been spent in combating swarms of locust hoppers, both by spraying and by trenching and burning them.

Enquiries as to insects attacking crops are received from outstations and dealt with as far as possible.

MADAN MOHAN LAL,
Assistant Professor of Entomology, Punjab, Lyallpur.

APPENDIX VI.

Report on the Lyallpur Agricultural Station by the Professor of Agriculture.

Owing to Mr. Roberts' absence on leave the writing of his annual report has devolved upon me.

1. *Season.*—The rainfall for the year was 9·57″ (*vide* statement No. I) as compared with an average of 15·49 inches for the past six years. The rain was however usefully distributed. Kharif crops, especially sugarcane and cotton, were benefited by the July and August rains while the rabi crops, though they suffered from the absence of the Christmas rains, were greatly helped by the good rainfall in February.

2. *Sugarcane, maize and cotton manurial experiments.*—The details of this experiment were fully explained in the annual report for last year. This year's results are shown in statements II, III and IV and on the whole bear out the results of the past two years.

(*i*) *Sugarcane.*—The two plots manured with nitrates in addition to castor cake have both given a heavier yield than the plots which received castor only In the case of the calcium nitrate plot the increased yield is over 4½ maunds of gur per acre while the potassium nitrate plot shows an increase of 10½ maunds. This corroborates last year's results when the two plots manured with nitrates gave an increased yield of 8 maunds.

(*ii*) *Maize.*—The crop suffered from white ant attack in its early stages, which accounts for the low yields and also prevents any conclusions being drawn as to the residual values of the manures upon the crop.

(*iii*) *Cotton.*—This year's results, which confirm the results of the past two years, show that there is no residual value left from the manures in the third year after application The high yields are largely due to the favourable season and to the cultivation which the land receives during the growth of the crop; this is rendered possible by sowing the crop in lines. Bollworm did damage early in the season when the first bolls were forming, but the parasite soon made its appearance and got the upper hand.

3. *Manurial experiments with sugarcane, maize and cotton in the kharif series, and gram, wheat and toria in the rabi series.*—The object of this experiment was explained in the annual report for last year. It is too early yet to draw any general conclusions from the results obtained.

This year's results are given in statements V to X.

Kharif series.—Sugarcane.—The nitrogenous manures seem to have raised the yield without lowering the quality of the gur.

Maize.—In all cases the application of manure has led to an increase in yield. Ammonium sulphate has produced the best results, and the three plots which received this manure have given the highest yields. The yields of all the plots are very high.

Cotton.—The yields of the several plots are very equal. Phosphatic manures seem to have little or no effect on the cotton crop.

Rabi series.—Gram.—As was to be expected, nitrogenous manures have produced no increase in the grain yields, but the bhusa yields are high in all cases where nitrogenous manures were applied.

In manured and unmanured plots alike the yields are exceptionally high, which may largely be attributed to the hoeings which the crop received.

Toria.—Farm-yard manure has given good results again this year.

Wheat.—The different manures had a very marked effect on the vegetative growth of the crop, as will be seen from the statement. Plots Nos. 26 and 30, which received ammonium sulphate, made very long straw, with the result that 65 per cent. of the crop lodged. Plot 32, which received calcium nitrate in addition to ammonium sulphate, grew even taller, with the result that the whole crop lodged, and the grain yield was consequently the lowest of any plot. The plots where nitrogenous manures had been applied, ripened considerably later than other plots.

The best result was obtained with bonemeal and lime. In this plot the crop stood up well, and the grain was of very nice appearance.

4. *Sugarcane varietal trial.*—Particulars are given in statement XI. The katha variety gave the best yield and the best quality of gur. This variety does not seem to require such a well-drained soil as the thicker varieties, Dhaulu and Kahu.

5. *Spacing experiment with American cotton* (*No.* 3 *F*).—Acre plots were selected for this experiment, and the treatment given to all the plots was the same. The yields were as follows :—

Distance between rows.	*Yield of kapas per acre in* Mds.	S.	C.
4½ feet	16	15	9
3 „	13	35	13
2 „	13	13	14

The three plots were very even in quality and made a very uniform growth; consequently these results are of value. The spacing of cotton must, however, always be regulated by the previous treatment which the land has received. After wheat it is probably sufficient to leave 2½ feet between the rows, while after toria or senji or a long fallow much greater distances can be left according to the richness of the land.

The mild winter greatly favoured the crop and the yields are very high. The kapas sold at Rs. 10-7-0 per maund, thus leaving a handsome profit.

6. *Calcium nitrate experiment with wheat.*—Again the results are very similar to those previously obtained. In one plot only out of four does the manure show a profit (*vide* statement XII).

7. *Desi* versus *Raja plough.*—This experiment, as in previous years, was conducted both on farm land and on land under tenants. Any publication of the results of the experiment on the farm area would merely be misleading owing to the unevenness of the land and the irregular growth made by the different plots. On the tenants' area the results are more reliable, though here too great difficulty is felt in getting land sufficiently uniform for experimental purposes. Six half-acre plots ploughed with the Desi plough gave an average acre yield of 18 maunds against 17 maunds in the case of six similar plots ploughed with the Raja plough.

8. *Hot weather* versus *rain ploughing for wheat.*—This experiment is conducted in an 8-acre block of land, 4 acres being ploughed in the hot weather (May) and 4 acres in the rains (August). The all-over yields last year favoured hot weather ploughing to the extent of 6 maunds. This year the difference is more marked, hot weather ploughing giving an increased yield of 13 maunds.

9. *Wheat varietal experiment.*—(*Vide* statements XIII & XIV). An exhaustive comparative test was this year made of types 9, 11 and 13, both on good and bad land, and the results are of interest in that they appear to confirm the conclusions drawn last year with respect to types 9 and 11. Last year it appeared that No. 9 was a variety of wheat suitable only for good land; the yields this year are all in support of this. Types 9, 11 and 13 were grown on good land on acre blocks (1) after cotton and (2) after wheat, with the following results :—

	AFTER COTTON. *Acre yields in* Mds.	S.	AFTER WHEAT. *Acre yields in* Mds.	S.
No. 9	28	0	 21	35
No. 11	26	8	 25	26
No. 13	24	16	 21	22

After cotton No. 9 yielded better than after wheat, the land being in better heart in the former case; while No. 11 yielded almost equally well in both cases.

On 14 acres of poorer land the same three types were grown side by side in plots varying from ¾ to 1 acre in extent. The average acre yields work out as follows :—

No. 9	14 maunds and 37 seers
No. 11	16 maunds and 16 seers
No. 13	15 maunds and 39 seers.

In some of these plots, which are situated near a village and where consequently the land is rich, No. 9 gave slightly higher yields than Nos. 11 and 13; while in the rest of the area, where the land is very light in texture, Nos 11 and 13 did very much better than No. 9. It seems therefore from these results and from the wheat survey which has recently been made in the Lyallpur district that No. 11 wheat is the most suitable for the colony generally. This wheat is to be sown on seed farms in the colony for distribution to zamindars. The land is now being ploughed.

Water requirements of wheat.—An experiment was this year started to find out whether a fourth watering for wheat is beneficial. It is not possible to draw any conclusions from one year's results which are given in statement XV. Late-sown wheat seemed to benefit from the 4th watering.

Wheats grown for the Imperial Economic Botanist, Pusa.—The remarks made in last year's report apply equally this year. Pusa 12 shows most promise. Pusa 106 has not done so well as last year, while type 9 E is not liked as well as Punjab type 9. The yields will be found in statement XVI along with yields of wheats grown by tenants.

Wheat yields—The yield of the farm wheat crop for this year averaged just over 17 maunds per acre on 32½ acres, while the yields on tenants' land averaged 15 maunds 35 seers per acre on 110 acres. Taking into consideration the fact that much of the area consists of a very light sandy soil, these yields are very satisfactory. The increased outturn of tenants' wheat is probably due to the use of iron ploughs during the past three years and to more careful cultivation generally.

10. Cotton varieties handed over by the Economic Botanist, Punjab—

American cotton.—The different types were grown side by side with Dharwar American cotton for comparison Types 3 F and 4 F, which promised well last year, were grown on large areas. On an area of 12½ acres type 3 F and Dharwar cotton were compared. Type 3 F averaged 9 maunds of *kapas* per acre against 5 maunds 17 seers by Dharwar; while on an area of 8 acres type 4 F averaged 10 maunds 21 seers against 6 maunds 29 seers by Dharwar. Types 3 F and 4 F are both excellent varieties; they are heavy yielders, the bolls open well and the fibre is long and silky. There is room for improvement, however, in the "kan", the percentage of lint to seed being lower than that of desi cotton. Though 4 F has given the greater yield, it is not such a suitable variety as 3 F for the colony owing to the fact that it matures much later, also the plants grow very tall. In a mild winter like the present 4 F has succeeded, whereas frost would usually catch it to a much greater extent than 3 F. 400 acres of seed farms, for the production of seed of 3 F, and 100 acres of 4 F, have this year been started by the deputy director of agriculture. With regard to the other strains of American cotton on trial types 126 F and 168 F show the most promise. Type 179 F is an early variety but the staple is not good.

Very big yields of American cotton have this year been obtained throughout the colony; prices too have ruled high, with the result that neither the agricultural department nor the ginning mills have been able to meet the demand for seed during this sowing season. There are now many hundreds of acres under American cotton in the colony.

Desi cotton.—"Farm selected" Gossypium Sanguineum has again yielded well and shown itself superior to the ordinary mixture grown in the colony. 100 acres of seed farms have this year been sown with this variety. The broad-leafed strain of "Farm Selected" shows promise of being an improvement upon ordinary farm selected, which is a mixture of both broad and narrow-leafed plants.

No. 2 desi (G. Neglectum) again yielded badly and has consequently been discarded.

11. *Cattle feeding experiments.*—*Gram* versus *cotton cake.*—In this experiment 8 bullocks received daily as concentrated food 2 seers each of gram, while another 8 bullocks received a similar quantity of cotton cake. Both lots of bullocks were given similar food otherwise and similar work, their weights were taken every fortnight and their condition noted. Little alteration either in weight or condition was noticeable during the trial, which, though only a rough one, indicates that cotton cake may be substituted for gram without ill effects, though the latter food is relished more than the former.

Silage versus *green fodder (*vide *silage experiment in last year's report).*—This experiment was carried out on similar lines to the above in order to test the feeding value of maize silage *versus* green senji. Here too both sets of bullocks kept in equally good condition, and the variation in weights was small. There was, however, a large percentage of waste in the silo, as maize, unless cut very green, does not settle down in the pit so quickly as green chari, and consequently more decomposition takes place. Maize "shredders" are now in use whereby the dried stalks, after the cobs have been harvested, are shredded and made palatable for cattle. One of these machines is now on trial at Pusa, and should it prove successful this method will probably prove more economical than the growing of maize for silage.

12. *Green manuring.*—The ploughing in of green crops of san hemp has again this year shown itself to be an economical method of improving poor land and increasing the outturn of the succeeding cereal crop. The practice is both simple and cheap. The seed is sown with the July rains and requires only one watering before being ploughed under at the end of August. The crop then gets two months in which to decompose in the soil before wheat sowings in the beginning of November. If the monsoon fails it is probably not practicable to sow san hemp, as all irrigation water is required for the cotton, sugarcane and toria crops, but provided good rains fall advantage should be taken of them in the manner described above.

During the past three years a green manuring trial has been conducted on a 3-acre block of light farm land. The results, which have been exceptionally good, are as follows :—

Year.	Manure.	Crop.	Yield per acre.
1910	None	Barley	3 Maunds 37 Seers.
1911	San hemp	"	16 " 27 "
1912	None	Gram	20 " 18 "
1913	San hemp	Barley... ...	26 " 20 "

The cost of growing and ploughing in the san hemp crop works out approximately as follows per acre :—

	Rs.	A.	P.
Cost of seed	2	0	0
One ploughing before sowing	1	0	0
One *sohaga* after sowing	0	8	0
One watering	0	8	0
One *sohaga* before ploughing in	0	8	0
Ploughing in crop with big plough ...	4	8	0
Rs. ...	9	0	0

General.—Two squares of uniform land adjoining the farm are on the point of being acquired, as at present there is very little land on the agricultural station which is sufficiently uniform for comparative experiments. The dairy, which is being started for the teaching of students is approaching completion. One square of farm land is being laid down to grass for the cows. Farm expenditure for the year amounted to Rs. 8,997-3-0 and receipts to Rs. 10,201-6-0. This increase in the income over previous years is due mainly to the increased outturn generally from tenants' lands and to the big yields and high prices obtained from the cotton crop. Considerable credit is also due to Chaudhri Muhammad Abdulla the farm manager.

H. SOUTHERN,

Professor of Agriculture, Punjab.

Statement No. I

Statement showing the rainfall at the Lyallpur Agricultural Station during the year 1912-13.

Month.		1912-13.		1911-12.	
		Number of rainy days.	Rainfall in inches.	Number of rainy days.	Rainfall in inches.
June 1912 ...	1st half	2	·24	1	·71
	2nd half	...	...	2	1·92
July 1912 ...	1st half	3	·84	1	·32
	2nd half	2	1·12	...	...
August 1912 ...	1st half	3	1·94	...	...
	2nd half	1	·22	2	1·47
September 1912	1st half	1	1·90	...	...
	2nd half	...	...	1	·25
October 1912...	1st half	1	·17	1	·25
	2nd half	...	...	...	...
November 1912	1st half	...	...	1	·25
	2nd half	...	...	...	...
December 1912	1st half	...	...	...	...
	2nd half	1	·18	...	...
January 1913	1st half	...	...	...	...
	2nd half	...	...	2	1·63
February 1913	1st half	2	·93	...	...
	2nd half	5	1·14	...	...
March 1913 ...	1st half	2	·44	...	...
	2nd half	...	...	...	...
April 1913 ...	1st half	...	...	2	·28
	2nd half	1	·17	5	·65
May 1913 ...	1st half	2	·28	...	...
	2nd half	...	...	...	...
	Total ...	26	9·57	18	7·73

STATEMENT No. II.

Statement showing the result of sugarcane grown in the manurial and rotation series at the Lyallpur Agricultural Station in kharif 1912.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area.		Weight of green tops.			Weight of canes.			Weight of juice.			Weight of gur.			Yield of gur per acre.			Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	Remarks.
				Kanals.	Marlas.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.					
	C / 5																								
27	1	Katha'	Castor cake at 10½ cwt. per acre.	3	4	66	9	0	106	28	0	57	25	0	10	16	0	26	0	0	62·07	54·00	18·04	9·74	Ploughings ... 1. Harrowings ... 11. Levelling with *sohaga* 11. *Sohaga* after sowing ... 8. Weeding and hoeings ... 5. Chain Harrowings 3. Waterings ... 16. Crushing began on 17th December 1912. Finished on 5th February 1913.
	2		Castor cake at 10½ cwt. per acre.	2	10	41	28	0	83	35	0	45	6	0	8	1	0	25	27	3	49·71	53·83	17·77	9·56	
	3		Castor cake at 10½ cwt per acre and calcium nitrate at 530·6 lbs containing 65 lbs. nitrogen per acre.	2	10	75	17	0	85	34	0	47	27	0	9	23	0	30	25	9	87·85	55·53	20·08	11·09	
	4		Castor cake at 10½ cwt. per acre and crude nitre at 488·36 lbs. containing 65 lbs. nitrogen per acre.	3	4	86	35	0	137	24	0	74	25	0	14	18	0	36	5	0	63·13	54·23	19·35	10·50	

STATEMENT No. III.

Statement showing the outturn of maize grown in the manurial and rotation series at the Lyallpur Agricultural Station in kharif 1912.

No. of square.	No. of plot	Name of variety.	Treatment.	Area.		Weight of dry stalks.			Weight of dry cobs.			Weight of grain.			Yield per acre.			Remarks.
				Kanals.	Marlas.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
	C / 2																	
7	1	Red local maize.	Residues of farm yard manure at 15 tons per acre and crude nitre 691·5 lbs. containing 65 lbs. nitrogen per acre.	4	0	6	22	0	6	31	6	5	14	6	10	28	12	Ploughings ... 2. Harrowings ... 15. Levelling with *sohaga*...11. Weeding and hoeings ... 3 Waterings ... 6 Date of sowing, 7th August 1912. Date of harvesting, 8th December 1912.
	2		Residues of farm yard manures at 15 tons per acre and basic Nitrate of lime at 532 lbs. containing 65 lbs. nitrogen per acre.	4	0	11	0	0	12	8	12	9	29	0	19	18	0	
	3		Residues of farm yard manure at 15 tons per acre.	4	0	11	17	0	12	4	0	9	19	8	18	39	0	
	4		Residues of farm yard manure at 15 tons per acre.	4	0	9	26	0	7	39	8	6	8	8	12	17	0	

STATEMENT No. IV.

Statement showing the result of residual effects of manures on farm-selected cotton grown in the manurial and rotation series at the Lyallpur Agricultural Station in kharif 1912.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area.		Actual outturn.			Outturn per acre.			Remarks.
				Kanals.	Marlas.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
	C 1											
27	1	Farm selected.	Fallow	4	0	5	31	6	11	22	12	Ploughings ... ... 1 Harrowings ... ... 13 Levelling with *sohaga* ... 2 Weeding and hoeings ... 10 Chain harrow ... ... 1 Waterings ... ... 8 Pickings began on 23rd October 1912, Finished on 27th December 1912,
	2		Residue of crude nitre at 495 lbs. per acre ...	4	0	4	23	10	9	7	4	
	3		Residue of crude nitre at 990 lbs. per acre ...	4	0	4	30	15	9	21	14	
	4		Fallow	4	0	4	21	6	9	2	12	

STATEMENT No. V.

Statement showing the outturn of sugarcane grown in the manurial block, standard kharif, area D, square 27, at the Lyallpur Agricultural Station in kharif 1912.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Weight of green tops.		Weight of canes.		Weight of juice.			Weight of gur.			Yield of gur per acre.			Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of juice to gur.	Percentage of gur to cane.	Remarks.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.					
27	12	Katha.	Unmanured ...	$\frac{37}{1320}$	2	23	3	20	1	27	0	0	12	8	11	5	15	73·57	47·85	18·65	8·92	Ploughings ... 2 Harrowings ... 14 Levelling with *sohaga* ... 7 *Sohaga* after sowing ... 4 Weeding and hoeing ... 5 Chain harrow ... 3 Waterings ... 16 Crushing began on 3rd December 1912, Finished on 16th December 1912.
	13		Calcium cyanamide at 3 cwts. 60·7 lbs. per acre.	$\frac{1}{5}$	39	20	53	28	28	32	0	5	0	0	25	0	0	73·95	53·63	17·36	9·31	
	14		Unmanured ...	$\frac{37}{660}$	8	29	8	39	4	35	0	0	28	0	12	19	7	97·21	54·31	14·35	7·79	
	15		Calcium nitrate at 4 cwts. 101·9 lbs. per acre.	$\frac{1}{5}$	44	7	47	18	24	0	0	4	8	0	21	0	0	93·09	50·57	17·5	8·75	
	16		Unmanured ...	$\frac{37}{660}$	7	14	8	18	4	30	0	0	28	0	12	19	7	86·98	56·21	18·94	14·73	
	17		Farm yard manure at 4 tons per acre.	$\frac{1}{5}$	36	13	52	20	24	18	0	4	3	0	20	15	0	69·19	46·57	16·66	7·76	
	18		Unmanured ...	$\frac{2}{55}$	7	28	8	5	4	25	0	0	30	0	20	25	0	94·76	56·92	18·2	9·23	
	19		Ammonium sulphate at 318 lbs. per acre.	$\frac{1}{5}$	42	12	51	23	29	32	0	4	35	0	24	15	0	82·01	57·77	16·35	9·45	
	20		Unmanured ...	$\frac{37}{660}$	7	30	6	31	3	16	0	0	23	0	10	10	4	110·7	50·18	16·91	8·48	
	21		Gypsum at 5 cwts. per acre.	$\frac{1}{5}$	21	13	19	6	9	8	0	1	18	8	7	12	8	111·35	48·04	15·89	7·61	
	22		Unmanured ...	$\frac{37}{1320}$	0	20	0	6	0	2	8	0	0	6	0	13	6	333·33	41·66	15·00	6·25	

STATEMENT No. VI.

Statement showing the outturn of maize grown in the manurial block, standard kharif, area D, square 27, at the Lyallpur Agricultural Station in kharif 1912.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Weight of dry stalks. Maunds.	Weight of dry stalks. Seers.	Weight of fresh cobs. Maunds.	Weight of fresh cobs. Seers.	Weight of fresh cobs. Chataks.	Weight of dry cobs. Maunds.	Weight of dry cobs. Seers.	Weight of dry cobs. Chataks.	Weight of grain. Maunds.	Weight of grain. Seers.	Weight of grain. Chataks.	Yield per acre. Maunds.	Yield per acre. Seers.	Yield per acre. Chataks.	Remarks.
27	23	Red local maize.	Unmanured	$\frac{37}{1320}$	0	38	0	30	0	0	20	8	0	17	0	15	6	7	Ploughings ... 3
	24		Bone meal at 2 cwt. 80 lbs. per acre and lime at 5 cwts. per acre.	$\frac{1}{5}$	7	9	8	32	0	6	35	0	5	23	11	28	38	7	Harrowings ... 13
	25		Unmanured	$\frac{37}{660}$	1	24	2	13	0	1	30	0	1	18	11	26	6	13	Levelling with *sohaga* ... 7
	26		Lime at 5 cwts. per acre and ammonium sulphate, 2 cwts. 109·76 lbs. per acre.	$\frac{1}{5}$	6	33	10	19	0	8	14	0	6	31	8	33	37	8	Weeding and hoeings ... 2
	27		Unmanured	$\frac{37}{660}$	0	30	1	37	0	1	21	0	1	10	0	22	11	14	
	28		Farm yard manure at 4 tons per acre ...	$\frac{1}{5}$	5	28	8	6	8	6	24	8	5	17	0	27	5	0	Waterings ... 6
	29		Unmanured	$\frac{37}{660}$	1	24	2	8	0	1	22	0	1	9	0	21	34	0	Date of sowing, 8th August 1912.
	30		Bone meal at 2 cwts. and 80 lbs. per acre and lime at 5 cwts. per acre and ammonium sulphate 318 lbs. per acre.	$\frac{1}{5}$	7	17	10	28	0	8	31	0	7	10	0	36	10	0	Date of harvesting, 2nd of December 1912.
	31		Unmanured	$\frac{37}{660}$	1	20	2	5	0	1	28	0	1	17	4	25	21	3	
	32		Superphosphate at 231 lbs. per acre and calcium nitrate at 4 cwts. 99·68 lbs. per acre and ammonium sulphate 2 cwt. 109·76 lbs. per acre.	$\frac{1}{5}$	7	6	9	11	0	7	22	0	6	3	0	30	15	0	
	33		Unmanured	$\frac{37}{660}$	1	20	2	2	0	1	30	0	1	18	4	25	39	0	

STATEMENT No. VII.

Statement showing the outturn of cotton grown in the manurial block, standard kharif, area D, square 27, at the Lyallpur Agricultural Station in kharif 1912.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Actual outturn. Maunds.	Actual outturn. Seers.	Actual outturn. Chataks.	Yield per acre. Maunds.	Yield per acre. Seers.	Yield per acre. Chataks.	Remarks.
27	1	Hansi cotton.	Unmanured	$\frac{37}{1320}$	0	1	12½	1	23	8	Ploughings 2
	2		Superphosphate at 231 lbs. per acre ...	$\frac{1}{5}$	1	0	1	5	0	5	Harrowings 13
	3		Unmanured	$\frac{37}{660}$	0	10	3	4	21	11	Levelling with *sohaga* ... 12
	4		Bone meal at 2 cwts. and 80 lbs. per acre ...	$\frac{1}{5}$	0	39	15	4	39	11	Weeding and hoeings ... 10
	5		Unmanured	$\frac{37}{660}$	0	12	0	5	14	0	Waterings 9
	6		Farm yard manure at 4 tons per acre ...	$\frac{1}{5}$	1	2	10	5	13	2	Picking began on 29th October 1912.
	7		Unmanured	$\frac{37}{660}$	0	9	13	4	15	0	Finished on 29th December 1912.
	8		Basic slag at 8 maunds per acre	$\frac{1}{5}$	0	37	1	4	25	5	
	9		Unmanured	$\frac{37}{660}$	0	12	10½	5	25	12	
	10		Lime at 5 cwts. per acre	$\frac{1}{5}$	1	1	8	5	7	8	
	11		Unmanured	$\frac{37}{1320}$	0	7	12		36	8	

STATEMENT No. VIII.

Statement showing the outturn of gram in the manurial series, standard R, area D, square 27, at the Lyallpur Agricultural Station, rabi 1912-13.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	Actual outturn.						Outturn per acre.						Remarks.
					Grain.			Bhusa.			Grain.			Bhusa.			
					Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	
27	12	Local Gram.	Unmanured	$\frac{37}{1320}$	0	20	0	0	16	0	17	33	8	14	10	12	Ploughings ... 5
	13		Calcium Cyanamide at 3 cwts. 60·7 lbs. per acre.	$\frac{1}{5}$	4	7	8	9	29	0	20	37	8	48	25	0	Harrowings ... 10
	14		Unmanured	$\frac{37}{660}$	1	10	0	2	9	0	22	11	14	39	27	9	Levelling with *sohaga* ... 3
	15		Calcium nitrate at 4 cwts. 99·68 lbs. per acre.	$\frac{1}{5}$	4	31	8	6	34	0	23	37	8	34	10	0	Weeding and hoeings ... 3
	16		Unmanured	$\frac{37}{660}$	1	22	0	1	38	0	27	25	15	34	31	5	Waterings ... 1
	17		Farm yard manure at 4 tons per acre ...	$\frac{1}{5}$	5	5	0	7	23	0	25	25	0	37	35	0	Date of sowing, 15th October 1912.
	18		Unmanured	$\frac{2}{55}$	1	2	0	1	7	0	28	35	0	32	12	8	Date of harvesting, 20th to 21st April 1913.
	19		Am. sulphate at 2 cwts. 109·76 lbs. per acre.	$\frac{1}{5}$	5	10	0	6	29	0	26	10	0	33	25	0	
	20		Unmanured	$\frac{37}{660}$	1	22	0	1	23	0	27	25	15	28	3	12	
	21		Gypsum at 5 cwts. per acre	$\frac{1}{5}$	5	6	0	5	14	0	25	30	0	26	30	3	
	22		Unmanured	$\frac{37}{1320}$	0	15	0	0	15	0	13	15	2	13	15	2	

STATEMENT No. IX.

Statement showing the outturn of Toria grown in the manurial block, standard R, area D, square 27, at the Lyallpur Agricultural Station, year 1912.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	Grain.			Straw.			Yield of grain per acre.			Remarks.
					Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	
27	1	Toria.	Unmanured	$\frac{37}{1320}$	0	8	8	0	22	0	7	23	4	Ploughings ... 3
	2		Superphosphate at 231 lbs. per acre	$\frac{1}{5}$	2	14	8	6	20	0	11	32	8	Harrowings ... 6
	3		Unmanured	$\frac{37}{660}$	0	35	0	1	29	0	15	24	5	Levelling with *sohaga* 1
	4		Bone meal at 2 cwts. and 80 lbs. per acre.	$\frac{1}{5}$	2	36	0	5	20	0	14	20	0	Chain harrow ... 1
	5		Unmanured	$\frac{37}{200}$	0	30	0	1	22	0	13	15	2	*Sohaga* after sowing... 1
	6		Farm yard manure at 4 tons per acre	$\frac{1}{5}$	2	35	0	4	32	0	14	15	0	Waterings ... 3
	7		Unmanured	$\frac{37}{660}$	0	26	0	1	7	0	11	23	12	Sown on 20th September 1912.
	8		Basic slag at 8 maunds per acre ...	$\frac{1}{5}$	2	27	0	4	30	0	13	15	0	Harvested on 12th January 1913.
	9		Unmanured	$\frac{37}{660}$	0	31	0	1	15	0	13	32	15	
	10		Lime at 5 cwts. per acre ...	$\frac{1}{5}$	2	26	0	4	35	0	13	10	0	
	11		Unmanured	$\frac{37}{1320}$	0	20	0	0	38	0	17	33	8	

STATEMENT No. X

Statement showing the outturn of wheat grown in the manurial series, standard R, area D, square 27, at the Lyallpur Agricultural Station in rabi 1912-13.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	ACTUAL OUT TURN.						OUTTURN PER ACRE.						REMARKS.
					Grain.			*Bhusa.*			*Grain.*			*Bhusa.*			
					Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	
27	23	Wheat, Type 9.	Unmanured	$\frac{37}{1320}$	0	31	0	1	35	0	27	25	15	66	35	10	Ploughings ... 3 Harrowings ... 13 Levelling with *sohaga* .. 6 Weeding and hoeing ... 1 Chain harrow ... Waterings ... 3 Date of sowing, 24th October 1912. Date of harvesting, 24th April 1913.
	24		Bone meal at 2 cwts. and 80 lbs. per acre and lime at 5 cwts. per acre.	$\frac{1}{5}$	5	32	8	16	11	8	29	2	8	81	17	8	
	25		Unmanured	$\frac{37}{660}$	1	15	0	4	3	0	24	21	1	72	27	7	
	26		Lime at 5 cwts. per acre and Am. sulphate at 2 cwts. 109·76 lbs. per acre.	$\frac{1}{5}$	5	5	0	19	33	0	25	25	0	99	5	0	
	27		Unmanured	$\frac{37}{660}$	1	10	8	4	27	8	22	20	12	83	24	9	
	28		Farm yard manure at 4 tons per acre ...	$\frac{1}{5}$	5	5	8	18	30	8	25	27	8	93	32	8	
	29		Unmanured	$\frac{37}{660}$	1	19	0	4	37	8	26	12	7	86	20	0	
	30		(1) Bone meal at 2 cwts. and 80 lbs. per acre. (2) Lime at 5 cwts. per acre ... (3) Am. sulphate at 2 cwts. 109·76 lbs. per acre.	$\frac{1}{5}$	5	8	8	20	0	8	26	2	8	100	0	8	
	31		Unmanured	$\frac{37}{660}$	1	20	0	5	1	0	26	30	4	89	25	6	
	32		(1) Super phosphate at 231 lbs. per acre (2) Calcium nitrate at 4 cwts. and 99·68 lbs. per acre. (3) Am. sulhpate at 2 cwts. 109·76 lbs. per acre.	$\frac{1}{5}$	3	33	0	21	10	0	19	5	0	106	10	0	
	33		Unmanured	$\frac{37}{650}$	1	15	0	5	14	0	24	21	0	95	17	4	

STATEMENT No. XI.

Statement showing the result of variety experiments with sugar cane at the Lyallpur Agricultural Station grown in kharif 1912.

No. of square and killas.	No. of plot.	AREA.		Variety.	Treatment.	WEIGHT OF GREEN TOPS.			WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.			OUTTURN OF GUR PER ACRE.		Percentage of green tops to canes.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
		K.	M.			Mds.	Srs.	Chs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Chs.	Mds.	Srs.					
$\frac{13}{13}$	B	1	12	Kahu ...	15 tons of farm yard manure per acre.	31	22	8	57	17	30	29½	5	0	0	25	0	54·96	53 52	16·26	8·70	$\frac{13}{13}$ Ploughings ... 1 Harrowings ... 4 Levelling with *sohaga* ... 4 *Sohaga* after sowing ... 4 Chain harrow ... 2 Hoeings ... 3 Waterings ... 13 Crushing began on the 19th December 1912. Crushing finished on 21st March 1913.
	C	1	10	Katha ...		31	10	0	69	30	37	24	6	9	0	33	8	44·80	53·70	16·55	8·92	
	D	1	14	Dhaulu ...		46	2	0	80	0	43	7	6	23	0	30	37	57·56	53·96	15·22	8·21	
$\frac{13}{12}$	B	1	5	Kahu ...		26	36	0	42	25	27	16	4	11	0	27	14	63·60	64·28	15·62	10·02	$\frac{13}{14}$ Plougings ... 1 Harrowings ... 10 Levelling with *sohaga* ... 2 *Sohaga* after sowing ... 4 Chain harrow ... 2 Hoeings ... 3 Waterings ... 13 Crushing began on 26th December 1912. Crushing finished on 23rd March 1913.
	C	2	9	Dhaulu ...		49	20	0	90	22	44	21	6	31	0	22	4	51·66	49·17	15·21	7·16	
	D	2	0	Katha ...		50	14	0	96	20	50	28	8	26	0	34	24	52·17	52·53	17·06	8·96	

STATEMENT NO. XII.

Statement showing the result of calcium nitrate experiment with wheat at the Lyallpur Agricultural Station, square 7, *Rabi* 1912-13, *variety Punjab Type* 11.

Np. of square and killas.	No. of plot.	MANURED.					No. of square and killas.	No. of plot.	UNMANURED.				INCREASE.				Increased revenue value of grain at Rs. 2-12 per maund and bhusa at Re. 0-4-0 a maund.			Expenditure at Rs. 10 per maund per 2nd of Ca (N O$_3$)$_2$.			Deficit.			REMARKS.
		Quantity of Ca (N O$_3$)$_2$ per acre.	AVERAGE OUTTURN PER ACRE.						AVERAGE OUTTURN PER ACRE.				PER ACRE OF													
			Grain.		Bhusa.				Grain.		Bhusa.		Grain.		Bhusa.											
			Mds.	Srs.	Mds.	Srs.			Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	
7/8	1	168 lbs.	15	8	28	28	7/8	2	7	4	13	12	8	4	15	16	26	1	11	20	7	9	0	0	0	Rs. A. P. 5 10 11 gain. Ploughings ... 3 Harrowings ... 3 Levelling with *sohaga* 4 Weeding and hoeings 3 Waterings ... 2 Date of sowing, 13th November 1912. Date of harvesting, 28th April 1913.
7/8	4	168 lbs.	19	4	33	28	7/8	3	13	20	28	12	5	24	5	16	16	12	0	20	7	9	3	11	9	
7/9	2	112 lbs.	16	20	33	4	7/9	1	12	32	24	24	3	28	8	20	12	4	10	13	10	6	1	5	8	
7/9	3	112 lbs.	18	12	33	24	7/9	4	15	0	27	4	3	12	6	20	10	11	2	13	10	6	2	15	4	

STATEMENNT NO. XIII.

Comparative test of wheat types Nos. 9, 11 *aud* 13 *grown at the Lyallpur Agricultural Station (good land), Rabi* 1912-13.

No. of squre.	No. of plot.	AREA.		No. of types.	Previous crop.	ACTUAL OUTTURN.						OUTTURN PER ACRE.					
						Grain.			Bhusa.			Grain.			Bhusa.		
		Kanals.	Marlas.			Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.
26	A 2/1 a	4	0	11	Wheat	11	35	12	24	12	4	23	31	8	48	24	8
	A 2/1 b	4	0	11	Do. —	13	30	8	18	22	8	27	21	0	37	5	0
	A 2/2 a	4	0	9	Do.	10	39	0	24	12	0	21	38	0	48	24	0
	A 2/2 b	4	0	9	Do.	10	36	8	21	37	8	21	33	0	43	35	0
	A 2/3 a	4	0	13	Do.	9	21	0	23	0	0	19	2	0	46	0	0
	A 2/3 b	4	0	13	Do.	12	1	0	33	30	0	24	2	0	67	20	0
	A 3/1 a	4	0	11	Cotton	11	21	0	18	10	0	23	2	0	36	20	0
	A 3/1 b	4	0	11	Do.	14	27	0	23	37	0	29	14	0	47	34	0
	A 3/2 a	4	0	9	Do.	13	35	0	27	37	0	27	10	0	55	34	0
	A 3/2 b	4	0	9	Do.	14	15	4	34	4	12	28	30	8	68	9	8
	A 3/3 a	4	0	13	Do.	12	4	0	29	0	0	24	8	0	58	0	0
	A 3/3 b	4	0	13	Do.	12	13	0	30	11	0	24	26	0	60	22	0

STATEMENT NO. XIV.

Comparative test of wheat Types Nos. 9, 11, 12 and 13 grown on large area (on poor land) at the Lyallpur Agricultural Station in rabi 1912-13.

No. of square.	No. of plot.	AREA.		No. of Type.	Previous crops.	ACTUAL OUTTURN.						OUTTURN PER ACRE.						REMARKS.
						Grain.			*Bhusa.*			*Grain.*			*Bhusa.*			
		K.	M.			Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	Mds.	Srs.	Chs.	
10	$\frac{\text{A 1}}{1}$	8	0	11	San hemp ploughed in.	15	25	0	27	1	0	15	25	0	27	1	0	
	$\frac{\text{A 2}}{1}$	8	0	9	Do.	16	34	0	37	16	0	16	34	0	37	16	0	
	$\frac{\text{A 1}}{2}$	8	0	11	Do.	21	37	0	41	26	0	21	37	0	41	26	0	Near village.
	$\frac{\text{A 2}}{2}$	8	0	9	Do.	20	27	0	45	6	8	20	27	0	45	6	8	
	$\frac{\text{B 1}}{1}$	8	0	13	Do.	13	3	0	29	8	0	13	3	0	29	8	0	
	$\frac{\text{B 2}}{1}$	8	0	11	Do.	12	31	0	25	26	0	12	31	0	25	26	0	
	$\frac{\text{B 1}}{2}$	8	0	13	Do.	18	6	0	41	9	0	18	6	0	41	9	0	Near village.
	$\frac{\text{B 2}}{2}$	8	0	11	Do.	17	26	0	30	12	0	17	26	0	30	12	0	
	$\frac{\text{C 1}}{1}$	6	0	9	Do.	9	29	0	23	35	0	12	$38\frac{2}{3}$	0	31	$6\frac{1}{3}$	0	
	$\frac{\text{C 2}}{1}$	8	0	13	Do.	16	32	0	38	10	0	16	32	0	38	10	0	
	$\frac{\text{C 1}}{2}$	8	0	9	Do.	12	30	0	28	24	0	12	30	0	28	24	0	
	$\frac{\text{C 2}}{2}$	8	0	13	Do.	16	20	0	35	13	0	16	20	0	35	13	0	
	$\frac{\text{D 1}}{1}$	6	0	9	Do.	8	24	0	24	12	0	11	$18\frac{2}{3}$	0	32	16	0	
	$\frac{\text{D 2}}{1}$	6	0	11	Do.	10	21	0	20	5	0	14	$1\frac{1}{3}$	0	26	$33\frac{1}{3}$	0	
	$\frac{\text{D 1}}{2}$	6	0	13	Do.	11	20	0	23	29	0	15	$13\frac{1}{3}$	0	31	$24\frac{2}{3}$	0	
	$\frac{\text{D 2}}{2}$	6	0	11	Do.	10	19	0	17	11	0	13	$38\frac{2}{3}$	0	23	$1\frac{1}{3}$	0	
2	22	4	0	11	Wheat ...	5	0	0	8	7	0	10	...	0	16	14	0	
	11	4	0	12	Do. ...	5	1	0	10	36	0	10	2	0	21	32	0	
	23	4	0	12	Do. ...	4	16	0	8	13	0	8	32	0	16	26	0	
	11	4	0	11	Do. ...	4	11	0	6	33	0	8	22	0	13	26	0	
	24	4	0	11	Do. ...	3	20	0	5	13	0	7	10	6	10	26	0	
	11	4	0	12	Do. ...	4	17	0	7	19	0	8	34	0	14	38	0	
	25	4	0	12	Do ...	4	24	7	7	2	0	9	8	0	14	4	0	
	11	4	0	11	Do. ...	5	30	0	9	8	0	11	20	0	18	16	0	

STATEMENT No. XV.

Statement showing the result of different numbers of waterings applied to the wheat crop at the Lyallpur Agricultural Station in rabi 1912-13.

FOUR WATERINGS.								REMARKS.	THREE WATERINGS.							
No. of square and killa.		*Area.*		No. of types.	*Outturn of grain per acre.*				*No. of square and killa.*		*Area.*		No. of types.	*Outturn of grain per acre.*		
Square.	Killa.	Kanals.	Marlas.		Maunds.	Seers.	Chhataks.		Square.	Killa.	Kanals.	Marlas.		Maunds.	Seers.	Chhataks.
5	21	1	2¼	9 E. 13 ...	24	18	0		5	21	1	2¼	9 E. 13 ...	17	3	2
"	"	1	2¼	" ...	23	36	6		"	"	1	2¼	" ...	26	2	10
7	7	2	2¼	" ...	11	37	0	Wheat lodged after last irrigation.	7	7	2	2¼	" ...	13	17	12
12	4	2	1	" ...	19	8	12		12	4	2	1	" ...	12	35	0

STATEMENT No. XVI.

Statement showing results of comparative sowings of wheat types grown with tenants at the Lyallpur Agricultural Station, rabi 1912-13.

AREA.		Type.	OUTTURN PER ACRE.			AREA.		Type.	OUTTURN PER ACRE.		
Kanals.	Marlas.		Maunds.	Seers.	Chhataks.	Kanals.	Marlas.		Maunds.	Seers.	Chhataks.
4	0	11	17	32	0	8	18	11	15	7	10
4	0	1	13	4	0	8	18	20	14	24	4
18	2	11	20	0	14	3	16	11	14	31	9
18	2	9	20	10	9	3	16	21	14	16	13
16	10	11	22	12	9	3	9	11	18	17	6
16	16	13	20	33	5	3	9	24	14	28	15
18	5	11	16	7	14	17	7	11	20	19	5
18	8	14	13	18	11	17	7	25	19	16	15
8	19	11	14	12	1	18	0	11	17	16	14
8	19	15	14	12	1	18	2	9 E. 1 ...	13	10	6
14	12	11	22	12	0	17	3	11	22	17	7
14	0	17	21	31	6	17	3	9 E. 13 ...	18	8	10
17	19	11	11	22	9	18	11	11	18	36	11
17	19	18	15	28	8	18	19	Pusa 106 ...	14	24	11
8	18	11	15	4	0	8	18	Pusa 12 ...	21	22	14
7	13	19	11	20	2	9	6	Pusa 8 ...	5	29	6

STATEMENT No. XVII.

Statement showing the yield of Economic Botanist's cotton grown on large areas with tenants at the Lyallpur Agricultural Station in kharif 1912.

Area.		Variety.	Total outturn.			Outturn per acre.		
Kanals.	Marlas.		Maunds.	Seers.	Chhataks.	Maunds.	Seers.	Chhataks.
41	16	Dharwar ...	29	37	10	5	17	3
57	9	Type 3 F. ...	65	13	4	9	0	11
31	10	Dharwar ...	27	19	11	6	29	5
30	10	Type 4 F. ...	42	2	1	10	21	8
4	12	Dharwar ...	7	6	14	12	13	14½
4	12	Type 126 F. ...	7	0	7½	12	7	14½
8	10	Dharwar ...	6	13	12	5	36	8
8	10	Type 161 F. ...	8	19	2	7	37	3
3	12	Dharwar ...	2	19	9	5	21	3½
2	8	Type 168 F. ...	2	13	1	6	4	13
3	7	Dharwar ...	1	39	12	4	26	13
21	9	Type 179 F. ...	22	22	13	7	12	12
15	6	Hansi old ...	11	7	4	5	28	2
15	6	F. Selected (G. Sanguineum).	13	3	7	6	26	12
7	14	Hansi old ...	9	8	2	9	22	13
8	8	F. S. (G. Sanguineum) (Broad leaf).	10	38	0	10	17	11
4	8	Hansi old ...	2	10	9	4	4	10½
4	8	2 Desi (G. neglectum)	2	6	9	3	37	1
4	0	Hansi old ...	2	20	8	5	0	6
14	0	Hansi new ...	8	33	15	5	32	9

APPENDIX VII.

REPORT ON THE GURDASPUR AGRICULTURAL STATION BY THE DEPUTY DIRECTOR OF AGRICULTURE.

1. *Introductory.*—Mr. Southern was in charge of the farm as Deputy Director of Agriculture till 10th of April 1913, when he relieved Mr. Roberts as Professor of Agriculture. I have since been acting for him.

2. *Season and its effect upon the crops.*—The total rainfall during the year was 29·05 inches, as compared with 21·45 for the last year (*vide* statement No. 1).

The season was favourable for kharif crops, but not so for rabi, as the rains ceased in the middle of August and from then to sowing time there was no rain ; but at the end of November there was a day's good rain, which helped things. After that there was a long spell of drought. The Christmas rains failed completely, and barani crops generally were drying up. Good rains in February and March saved the crop, which recovered wonderfully, but disturbed the pollination and thereby decreased the outturns of early ripening varieties of wheat. The hot winds in April ripened off the crop too fast and the grain was generally light and shrivelled. The season was very unfavourable for threshing

3. *General.*—The agricultural station is divided into (1) a chahi area where sugarcane is the chief subject of our investigations, and (2) a barani area where experiments with wheat cultivation and the investigation of the possibilities of increasing the fertility and moisture capacity of barani soils are being carried out. The area is now on the whole well controlled and proper rotations have been started.

An Ashford tube well has been sunk for the irrigation of the chahi area and is working satisfactorily. The wheat in the chahi area in the year under report was barani as the tube well was put in late.

4. *Chahi area.*—As mentioned in last year's report, the rotation of the district—sugarcane, wheat, maize with a catch crop of senji (Melilotus Parviflora) between the maize and sugarcane crop—has been adopted on this area and 10 acres come under sugarcane every year.

Sugarcane (*Statement No.* 2).—About 40 varieties, local and foreign, were planted. Of these 15 were discarded as being quite unsuitable, while the remaining, which were promising, have been planted on a larger scale. Frost did some temporary damage in reducing the sucrose contents, but these increased constantly afterwards Kaha suffered from red rot and being also very late was not crushed. Katha canes suffered from smut, while dhaulu canes were practically free of it. The quality of gur was poor in the beginning, but improved as the season advanced. The land being new and rich had the effect of latening the maturity of the sugarcane crop generally. Ponda was very poor, as it was badly attacked by white ants, which are very numerous in the adjoining district board gardens and are much attracted by the thick canes.

Maize.—A comparative test of maize sown in lines 2′ apart and broadcasted was conducted. Immediately after sowing there was a heavy shower of rain which was very favourable for the broadcasted plot. The seed in the drilled area rotted for the most part. The weeds were enormous and the interculture with Gujrat hoes was a matter of great difficulty, as the hoes got choked, when the weed stuck to the blade.

The yields were :—

	Mds.	Srs.
Broadcasted	19	8 per acre.
Drilled	7	5 ,,

The experiment is being repeated on a large scale this (1913) kharif.

5. Ground nuts were tried on a small scale, but a fungus appeared and the leaves withered and fell down. The crop failed.

6. *Cotton varieties* (*Statement No.* 3).—Three varieties of cotton were grown for the Economic Botanist, Punjab. In places the crop suffered from root rot. Withal the outturn was good.

7. *Saccharine Juar* (*Statement No.* 4).—Some seed of this Juar was obtained from M. Qutab Din, retired extra assistant commissioner of Sialkot, who was said to have prepared good gur from it. It was an interesting trial, as the crop is less expensive and takes half as much time as sugarcane. The stalks were analysed by the Agricultural Chemist from time to time, and two boilings at different dates were made. The gur prepared was very inferior and poor in crystals. It was dirty coloured with an acid taste. It did not solidify and there was no market for it. It has been decided not to give it any further trial.

8. *Mash.*—A considerable area was put under this crop, but the crop failed. A fungus attacked the leaves badly. Mash has now been sown after wheat on the barani area. There were two objects in view,—(1) to add nitrogen to the soil, and (2) to try a crop which is common in the tract and paying. The fodder too is good for cattle during winter.

9. *San hemp.*—San hemp was grown on about 1½ acres with a view to ascertain the market value of the fibre. The outturn of fibre per acre was 3 maunds and 17 seers. Samples were sent to Messrs. Moll Schotte and Co. and Messrs. Shaw Wallace and Co , Calcutta. There was some difference of opinion as to its colour. It was not very well retted. Length was reported to be fair and the quality good and similar to the better quality that comes from Raigarh in the Central Provinces. The fibre was said to be strong. Messrs. Wallace and Co. are of opinion that it would find a ready sale in London after being cleaned by hackling : they rated it at Rs. 10 per maund *f. o. r.* Calcutta. Moll Schotte and Co. rated it at Rs. 8-12-0 to Rs 9. It was sold at Gurdaspur at Rs. 8 per maund.

10. *Rabi.*—In rabi the following work was done on wheat :—

(A) Varietal trials.

(B) Experiments with different treatments, *viz.*—

(1) Tillage. (A rolling after sowing and unrolled.)

(2) Deep and shallow ploughing.

(3) Bone meal and unmanured.

(C) Comparative test between the two barani wheats Pusa 12 and Punjab 13; also between the local 13 and 14.

(A). *Varietal trials.*—All the Punjab 25 types were sown this year again and the last year's results as regards rust and earliness were confirmed. Next year only those types will be grown which promise to be good barani wheats. As last year year, the common wheats of this district (types 13 and 14) gave good results.

(B) Different treatments of tillage,—*vide* statement No. 5—

Rolling after sowing and unrolled. } The experiment was duplicated in alternate
Deep and shallow ploughing. } plots.
Bone meal and no manure. }

The alternate plots were treated alike. Rolling has given no advantage. It was done with a view to bringing moisture up to help the germination of seed and development of roots. As in last year so too this year deep ploughings gave better results. Bone meal gave an increased yield, but not enough to make the manure profitable.

(C) A comparative test of types 13 and 14—the two local wheats—was again carried out this year. The great disadvantage in No. 13 is that it is very late in ripening. There were late rains which improved the general condition of the crop, but lengthened its ripening period. Hot weather set in soon after, and the dry western winds dried up the crop before the grain was fully developed and well filled. No. 14 this year has been better than No. 13 as regards outturn of grain per bushel (see Statement No. 6.)

11. *Comparison of Punjab* 13 *and Pusa* 12 (*Statement No.* 6).—Last year Pusa 12 and Punjab 13 bothgave good results, and Pusa 12 promised to be as good a barani wheat as the local No. 13. Accordingly for a comparative test these two were sown side by side on a large scale, the condition and the treatment of the land being quite similar. To begin with Punjab 13 showed well. It tillers much more than Pusa 12, which was a thin crop, but the latter has a bigger head and has given a much higher outturn than No. 13. Its grain was big and gave a very uniform sample, while 13 was shrivelled and its sample was comparatively ugly and uneven. Pusa 12 promises to be a good barani wheat and suitable for tracts where a beardless wheat is liked.

12. *Pusa wheats, Nos.* 106 *and* 8 (*Statement No.* 6.)—Pusa wheats Nos. 106 and 8 were again tried this year with local No. 13 as a check crop in duplicate plots. The Pusa wheats were very poor. Their growth was stunted. They are more liable to rust. It has been decided to discard them altogether.

13. *Pusa* 4 *and* 6.—These two new types were received from the Imperial Economic Botanist, Pusa, and given a trial. Both show promise. They had fine heads, but tillered poorly. Pusa No. 4 was freer from rust. It is slightly later than No. 6 but gave better results. They will be again given a trial next year. Their outturn has been —

	Per acre.	
	Mds.	Srs.
Pusa 4	14	35
Pusa 6	9	19

14. *Characteristics of Pusa wheats* (12, 4, *and* 6) *and local* (13 *and* 14).—The Pusa wheats mature a fortnight earlier than the local wheats and some 3 weeks earlier than local No. 13. As soon as they come above the ground, they assume an erect habit and grow quickly, tiller very little and soon become tall. They do not withstand drought well. They have fine big heads, but the appearance of 5 or 6 big heads seems to exhaust the plant, after which they ripen quickly. They have however the advantage of ripening up very early all at one time. The local wheats, on the contrary, spread out flat over the ground when they come up, and form thick tussocks, which gradually assume an erect habit. They have a very leafy appearance and withstand drought in an amazing manner. In years of bad rust they rust badly, as they have such a heavy leaf growth but it does them little harm, as it is usually over before they start to ear, but just when the rust is at its worst on the leaves of the local wheat, the Pusa wheats start earing and get badly rusted in the head.

15. *Ottawa wheats.*—Two pounds of seed of Ottawa wheat crossed with red Karachi was received from Ottawa. It was a beautiful red wheat but was very late. The grain too was much shrivelled due to its late ripening.

16. *Harrowing of young wheat.*—For this work lever peg toothed harrows have been found better than the chain harrow, for the latter spoils the appearance of the crop and the former improves it. The only defect in these lever harrows is that they are not flexible and do not fit hollows as chain harrows do. The addition of an adjustable hake to them would also be a great improvement.

17. *Calcium nitrate.*—At the instance of the Kashmir Darbar calcium nitrate was tried as a manure for barani wheats. The fertilizers arrived very late and calcium cyanamide could not be given a trial. Calcium nitrate, however, was tried in zamindars' fields near the farm in the two villages of Abul Khair and Kamalabad. The quantity applied was 1½ and

3 cwts. respectively. In the former village it was sown along with the seed. In the latter it was applied as a top dressing and was broadcasted, when the crop was about 6″ high a chain harrow being run over it. The treated areas, gave higher outturns than the untreated :—

Name of village	TREATED.				UNTREATED.			REMARKS.
	Area in acre.	Quantity of Nitrate applied.	Outturn.	Outturn per acre,	Area in acre.	Outturn.	Outturn per acre.	
		Cwt.	Mds Srs.	Mds. Srs.		Mds. Srs.	Mds. Srs.	
1. Abdul Khair ...	1	1½	6 7	6 7	½	2 2½	4 5	—
2. Kamalabad ...	1	3	16 0	16 0	1	13 0	13 0	

The land at Abul Khair was very poor and far poorer than that of Kamalabad. The effect of the manure in both cases was to make the crop late. With the March showers it improved much and showed a marked and marvellous difference in growth and colour, especially in the leaves.

The grain for the most part of the treated fields was shrivelled, probably due to lateness.

18. *Visitors.*—The farm is now well known and much frequented by zamindars interested in agriculture. Two Deputy Commissioners (Messrs. Townsend and Usborne), a number of tahsildars, kanungos and zaildars visited the farm in March and April last. Members of the Co-operative Credit Societies of the Gurdaspur district visited the farm twice. All visitors were shown round the farm and implements were demonstrated to them in working order. There has been some trouble in housing the visitors, but it is expected that some arrangements will soon be made for the convenience of the outsiders. Besides the above Mr. Diack, Financial Commissioner, Punjab, the Commissioner of the Lahore division and the Agricultural Adviser to the Government of India also paid visits to the farm.

19. *Staff.*—M. Charan Singh, farm manager, has rendered valuable help in carrying out the experimental work.

M. FATEH-UD-DIN,

Offg. Deputy Director of Agriculture, Punjab.

STATEMENT 1.

Statement of rainfall during the years 1911-12 *and* 1912-13.

RAINFALL DURING 1912-13.		RAINFALL DURING 1911-12.	
Name of month.	Rainfall.	Name of month.	Rainfall.
June	0·03	June	3·39
July	9·66	July	1·83
August	11·76	August	6·50
September	0·41	September	2·23
October	...	October	·24
November	0·80	November	1·75
December	0·04	December	...
January	0·50	January	4·03
February	2·91	February	·07
March	1·76	March	·24
April	–	April	·91
May	1·18	May	·26
Total	29·05	Total	21·45

STATEMENT No. 2.

Statement of experiment of different varieties of sugarcane.

Serial No.	No. of field and plot.	Name of variety.	Area harvested, in square yards.	WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF CANES PER ACRE.		WEIGHT OF JUICE PER ACRE.		WEIGHT OF GUR PER ACRE.		Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.			
1	VI 6/2	Dhaulu	2,420	233	37	130	35	18	8	467	34	261	30	36	16	55·9	13·77	7·7
2	I	Do.	8,524	499	6	278	20	40	25	283	16	158	5	23	3	55·79	14·4	8·13
3	VI A	Do.	1,613	146	25	85	30	11	32	439	35	257	10	35	16	58·48	13·46	8·04
4	Do.	Suretha	754	62	4	39	20	6	20	398	25	253	22	41	26	63·6	16·45	10·46
5	I	Do.	146	17	3	10	21	2	0	566	2	348	36	66	12	61·64	19·002	11·7
6	I	Cawnpuri	202	18	20	9	20	1	28	443	10	227	24	40	29	51·35	17·89	9·18
7	I	Lal hard	176	19	29	11	20	1	19	542	17	316	10	40	21	58·3	12·82	7·47
8	I	Salark	100	10	30	6	0	1	3	520	28	290	16	52	3	55·81	17·91	10·0
9	I	Dag	124	8	23	4	20	0	32	334	31	175	26	31	9	52·47	17·77	9·32
10	I	No. 3	122	9	24	5	10	0	38	380	34	208	11	37	27	54·63	18·47	9·89
11	I	Chin	649	64	14	34	20	5	38	479	35	257	11	44	8	53·61	17·24	9·24
12	I	Barhai	345	39	2	22	0	3	22	547	32	308	25	49	32	56·33	16·13	9·09
13	I	Manga	60	6	6	3	15	0	20	496	4	272	10	40	27	54·87	14·81	8·13
14	VI A	Dhoura of Azamgarh	340	38	21	22	4	2	37½	548	16	314	28	41	32	57·36	13·29	7·62
15	I	Mutka Mango	26	7	24	3	13	0	21	1,414	30	619	38	98	29	43·35	17·78	6·9
16	I	Tareru of Batala	126	16	37	7	10	1	15	650	5	278	19	52	32	42·82	18·96	8 12
17	I	Dhaulu Suretha	142	10	19	7	8	1	2	357	1	245	16	35	31	68·73	14·58	9·9
18	I	Mamcha of Basali	45	3	25	1	30	0	9	389	35	188	8	24	8	48·27	12·85	6·2
19	I	Katara	46	4	13	2	4	0	11	455	2	220	38	28	37	48·55	13·09	6·35
20	I	Patarki Mango	111	9	39	5	10	0	31	434	37	228	36	33	31	52·63	14·76	7·76
21	I	Reora of Benares	48	5	18	2	10	0	17	549	21	226	35	42	34	41·28	18·88	7·7
22	I	Betakali of Damraon	83	12	5	6	10	1	2	707	2	364	16	61	9	51·54	16·1	8·65
23	I	Katha of Batala	318	23	3	13	5	2	20	351	8	199	30	38	2	56·87	19·04	10·8
24	I	Dhoura Kanar	67	6	37	4	0	0	22	500	10	288	38	39	29	57·76	13·75	7·9
25	I	Merthi	200	15	5	9	20	1	16	366	1	286	5	42	14	62·8	14·73	9·25
26	I	Desi Suretha	100	9	7	5	20	1	4	444	3	266	8	53	9	59·94	20·0	13·16
27	I	Matna	78	8	0	5	0	0	32	417	16	310	10	49	25	62·5	16·0	10·0
28	I	Badi	24	7	3	4	4	0	25	1,426	32	826	33	126	2	57·95	15·24	8·83
29	I	Bangar No. 4	32	3	11	2	1	0	18	495	14	306	11	68	2	61·80	13·74	22·2
30	I	Kansar of Batala	265	31	10	16	30	2	38	570	30	305	37	53	35	53·6	17·61	9·44
31	I	Kansar	163	14	30	7	0	0	36	437	39	207	34	26	29	47·45	12·85	6·1
32	I	No. 5	72	8	24	3	20	0	26½	578	4	235	11	44	21	40·69	18·92	7·78
33	I	Reora of Benares	278	34	25	17	30	2	28	602	33	309	1	47	0	51·26	15·21	7·79

STATEMENT No. 3.

Statement of cotton varieties sown in 1912-13.

Name of variety.	Actual area picked, in square yards.	Actual outturn.	Outturn per acre.	Lint percentage.	Treatment.	Hoeing.	Waterings.	Date of sowing.	REMARKS.
Lyallpur (Desi) ...	1,613⅓	4 5 1	12 5 3	32·25	8 inches deep ploughing with 450 maunds of manure per acre.	Two with bullock hoes.	Two	12th May 1912.	1. The land was rich.
Farm selected (G. Sanguineum).	1,613⅓	3 2 3	9 6 9	29·5				Do.	2. These were sown on flat ground.
199 F. American ...	1,613⅓	4 0 11	12 2 1	31·5				Do.	3. Sown in chahi area under chahi conditions.

STATEMENT No. 4.

Statement of yield of gur prepared from saccharine juar.

No. of field and plot.	Area reaped, in square yards.	WEIGHT OF STALKS.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF CANES PER ACRE.		WEIGHT OF JUICE PER ACRE.		WEIGHT OF GUR PER ACRE.		Percentage of juice.	Percentage of gur to canes.	Percentage of gur to juice.	Date of boiling.	REMARKS.
		Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
7 (1, 2, 5 & 6)	1,265½	10	13	5	22	0	30½	39	19	21	9	2	$36\frac{5}{8}$	53·7	7·38	13·7	23rd October 1912.	The gur was more like molasses.
7 (3, 4, 7 & 8)	1,265½	16	10	8	10½	1	7	62	5	31	24	4	$19\frac{9}{16}$	50·769	7·23	14·24	5th November and 6th November 1912.	

STATEMENT No. 5.

Statement showing the result of different treatments on wheat.

Field No.	Wheat No.	Actual area reaped.	Treatment.	Actual Outturn.				Outturn per acre.				Weight of grain per bushel.		Remarks.
				Grain.		Straw.		Grain.		Straw.				
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Seers.	Chattaks.	
18	Punjab 13	3,200	Ordinary	7	0	20	8	10	23½	30	22	32	6	Date of sowing, 30th and 31st October 1912.
18	Do. 13	4,800	Rolling with Cambridge roller after sowing.	12	0	30	7	12	4	30	17	32	9	Date of harvesting, 5th and 6th May 1913.
18	Do. 13	4,800	Ordinary	12	2	30	21	12	6	30	31	33	4	Number of Raja ploughings 2 Harrowings ... ... 9 Wheat-harrowings ... 4 Hoeings ... .. *Nil.* Irrigation ... ...*Nil.*
18	Do. 13	4,778	Deep ploughing in summer.	11	22	26	10	11	28	26	33½	32	5	
18	Do. 13	4,780	Ordinary	9	12	22	9	9	17	22	20	32	5	*General condition.*—Crop late, germination regular ; smut present ; rust on leaves.
18	Do. 13	4,800	Bone meal 5 cwts. per acre.	12	28	33	39	12	32	34	10	32	5	
18	Do. 13	4,800	Ordinary	11	37	31	6	12	1	31	16	32	2½	

STATEMENT No. 6.

Comparative statement of wheat yields.

Field No.	Type No.	Actual area reaped in square yards.	Actual outturn.						Outturn per acre.						Weight of grain per bushel.		Remarks.
			Grain.			Straw.			Grain.			Straw.					
			Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	Seers.	Chataks.	
21	Punjab 13	6,264	17	0	0	35	30	0	13	5	0	27	25	0	32	11½	Date of sowing, 3rd November 1912. Date of harvesting, 1st May 1913.
21	Do. 14	6,275	18	32	0	37	4	0	14	20	0	28	24	0	31	14½	Number of ploughings, with Raja plough ... ... 2 Harrowings ... ... 5 Wheat harrowings ... 4 Hoeings ... ... *Nil.* Irrigation ... ... *Nil.* *General condition.*—Germination regular, rust present on leaves in both the varieties, smut in No. 13.
22	Punjab 13	3,027	11	0	0	27	3	0	17	23	0	43	11	8	33	14	Date of sowing, 4th November 1912. Date of harvesting, 24th and 25th April 1913 and 28th April 1913.
22	Pusa 106	4,393	8	0	0	17	20	0	8	32	0	19	11	0	33	3	Number of ploughings with Raja plough ... ... 2 Harrowings ... ... 7 Wheat harrowings ... 3 Hoeings ... ... *Nil.* Irrigation ... ... *Nil.* *General condition.*—Pusa 8 and 106 early, rust in head very bad ; it was present on leaves too.
22	Do. 8	3,648	5	30	0	14	4	0	7	25	0	18	28	0	32	2½	No. 13 late, rust on leaves, smut in No. 13.
5	Pusa 12	8,827½	35	8	0	75	7	0	19	12	0	51	12	0	33	2	Date of sowing, 2nd-3rd November 1912. Date of harvesting. Punjab 13 on 13th April 1913. Pusa 12 on 24th April 1912.
5	Punjab 13	8,874	26	12	0	80	3	0	15	13	0	43	27	0	32	11½	Raja ploughings ... ... 2 Harrowing ... ... 9 Wheat harrowings ... 2 Smut in 13. Tillering very good.
16	Do. 13	11,825	32	35	0	88	31	0	13	18	0	34	35	0	32	13	Date of sowing, 1st and 2nd November 1912. Date of harvesting,, 26th April 1913 for Pusa 12 ; May 1913 for Punjab 13.
16	Pusa 12	11,835	33	23	0	54	27	0	13	30	0	22	15	0	31	¾	Raja ploughings 2 Harrowings ... 0 Wheat harrowings 3 Pusa 12 earlier than Punjab 13, which had smut. Rust in heads in Pusa 12, which is poor in tillering.

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REPORT

ON THE OPERATIONS
OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1914.

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Proceedings of His Honour the Lieutenant-Governor of the Punjab in the Department of Revenue and Agriculture (Agriculture), No. 320, dated 18th November 1914.

READ—

Letter No. 895, dated 16th October 1914, from the Senior Secretary to the Financial Commissioners, Punjab, forwarding, with the comments of the Officiating Financial Commissioner, the Annual Report on the operations of the Department of Agriculture in the Punjab, for the year ending 30th June 1914.

REMARKS.—The superior staff of the Department has been increased by the appointment of a 2nd Deputy Director. He is being employed for the present at the new Agricultural Station at Hansi and in investigating the many important agricultural problems in this portion of the Punjab. A third Deputy Director has also been sanctioned and has recently arrived, whilst the new Agricultural Engineer will, it is hoped, shortly be entering upon his duties. The Director still complains of the insufficiency of the leave reserve of European experts. The Lieutenant-Governor, however, is not at present prepared to represent the matter to the Government of India.

2. Progress at the College at Lyallpur is far from encouraging. It was found impossible to hold a first year class from lack of students. The short vernacular class for sons of zamindars however holds out some prospects of success and will, it is hoped, soon become popular and be well attended. The Director's proposals for the improvement of the pay of Agricultural Assistants are still under consideration. His Honour agrees with him that it is necessary to make some improvement in order to attract the right class of men to the College. He is not, however, prepared to carry this principle so far as to accept the somewhat sweeping proposals put before Government and the delay of which the Director complains would have been avoided had the scheme submitted been less ambitious. With the changes which have now been made in the curriculum, the course for students desirous of becoming Agricultural Assistants will be shorter, easier and cheaper, and it is hoped that this fact, together with the proposed increase in emoluments, will encourage recruitment.

3. Owing to adverse climatic conditions the year has not been favourable for experimental work with regard to wheat, whilst cotton experiments were largely ineffectual owing to an unfortunate mistake on the part of the Department in distributing seed of 3F. American cotton, a variety which on account of its smooth leaves is particularly liable to attack from leaf insects. It is to be feared that this mistake will shake the confidence of the zamindars in the Department and may retard the progress in popularity of American cotton. Experiments with indigenous cottons continue but without any decisive results at present.

As the Financial Commissioner has pointed out, Government have not yet agreed to lease land on the Lower Bari Doab Canal to the Imperial Federation of Cotton Spinners for a model plantation of American cotton. The general idea of the proposal has been approved, but there have been no further negotiations on the subject. The lease, if sanctioned, and the grant to Mr. Conville, should result in valuable object-lessons to the zamindar.

4. An important experiment which is now being carried out is the Reh reclamation experiment at Narwala. If successful it should have far-reaching results in view of the large alkali-affected tracts in the Punjab which are at present unfit for cultivation. Progress, however, on the work has not been very rapid.

Investigations in connection with the wheat weevil, the cane-borer and other pests have been continued. The Professor of Agriculture has conducted a number of experiments which tend to show that at present no artificial manure can be used with profit. The Lieutenant-Governor agrees with the Financial Commissioner that it is desirable that the financial results of experiments should be indicated as far as possible.

5. There is practically no improvement in the sales of western agricultural implements. The Director remarks that he is unable to understand why more zamindars do not buy the Raja plough and is of the opinion that many more demonstrators are required. His Honour agrees entirely with Mr. Maynard that "the best demonstrator is a cultivator who has himself used an implement and *found it profitable.*" The rapidity with which the Bihar sugar mill has superseded the indigenous press is a notable example of the truth of this principle. A thorough knowledge of the language, habits and customs of the agricultural community is an essential part of the equipment of the superior agricultural staff if they are to gain the confidence of the people, and His Honour trusts that the Director will keep this before the minds of all officers in the Department.

6. The account of the operations of the well-boring staff is more encouraging than last year's report on the subject, but there is still difficulty in finding steady employment for the borers The percentage of successful borings, too, is disappointing. This is no doubt largely due to the want of expert supervision, but with the appointment of the Agricultural Engineer this difficulty should be removed and these very important operations should give better results. As regards the minor activities of the Department, there has been some progress in sericulture and the experiments in olive cultivation are being continued.

7. The popularization of improved methods by means of Co-operative Credit Societies is a matter which is receiving careful attention. The societies have been useful as seed distributors, in arranging demonstration and stocking implements for sale, but there are, as the report shows, limitations on their utility. The Lieutenant-Governor, however, is inclined to agree with the Financial Commissioner that our object should be to make co-operation in agriculture and in the marketing of produce a pendant to co-operation in credit and there is much to be said in favour of working through established Co-operative Societies, which have been eminently successful in their primary object, rather than in multiplying the number of associations. This should not prevent the formation of special Agricultural Associations where there is a genuine spontaneous demand for them, and the Associations which have been formed in several districts give some promise of rendering useful service to the agricultural community in the introduction of improved methods. His Honour is prepared to consider favourably any reasonable scheme which the Director may submit for giving assistance to these associations, but no proposals have hitherto reached Government except a recent suggestion, that they should be given funds to purchase books and other publications on agricultural subjects, which has been sanctioned.

8. In more than one place in the report the Director has complained that the Department is starved financially and appears to attribute the slow progress to this cause. In this connexion the Financial Commissioner's note contains some just remarks, and the Director may rest assured that well-thought-out and well-presented schemes will always receive due consideration.

9. Sir Michael O'Dwyer is confident that the officers of the Department will realize that at present they are but pioneers in agricultural improvement and will aim at a slow and steady progress on the foundations which they have already laid, and he has no doubt that their zealous efforts will ultimately meet with well-deserved success. His Honour's acknowledgments are due to Mr. Hamilton for his administration of the Department during the past 3½ years and for his report which, like its predecessors, is full of interest. But the Lieutenant-Governor sees no justification for the pessimistic note which pervades it. Mr. Maynard has surveyed the whole question of agricultural progress from a broader standpoint and in His Honour's opinion his admirable and suggestive review gives a true picture of the success which has already been attained and a correct estimate of the development that may be hoped for in the near future.

ORDER.—Ordered that a copy of the foregoing remarks be forwarded to the Junior Secretary to the Financial Commissioners, Punjab, for information; that they be published in the *Punjab Gazette*, and submitted to the Government of India in the Department of Revenue and Agriculture.

By order of His Honour the Lieutenant-Governor of the Punjab,

J. P. THOMPSON,

Revenue Secretary to Government, Punjab.

1959 CS—450—24-11-14—SGPP Lahore.

No. 895.

FINANCIAL COMMISSIONERS' OFFICE:
Dated Lahore, 16th October 1914.

FROM

MILES IRVING, ESQUIRE,
Senior Secretary to the Financial Commissioners, Punjab,

To

THE HON'BLE MR. J. P. THOMPSON,
Revenue Secretary to Government, Punjab.

The Hon'ble Mr. H. J. Maynard.

SIR,

Sub-head 491.
File No. 50.

I AM directed to submit the Annual report on the operations of the Department of Agriculture, Punjab, for the year ending 30th June 1914, together with a separate note containing the comments of the Hon'ble Mr. H. J. Maynard, officiating Financial Commissioner.

I have the honour to be,
SIR,
Your most obedient servant,
MILES IRVING,
Senior Secretary to the Financial Commissioners, Punjab.

241 FC—370—2-11-14—SGPP Lahore.

Note by the Hon'ble Mr. H. J. Maynard, Financial Commissioner, Punjab.

Staff.

1. At various places in his report Mr. Hamilton refers to proposals submitted by him for expenditure on the Department. These are the provision of a leave reserve, improvement of the pay of the Assistant Directors and subordinate staff, the appointment of an Assistant Agricultural Chemist and an Entomologist, buildings at the Hansi farm and one or two minor objects. These, as far as the Financial Commissioner has been able to support them, have been placed before Government, and Mr. Maynard thinks it unnecessary to deal with them in connection with this report. With a commendable zeal for the interests of his department Mr. Hamilton comments on the inadequacy of the financial provision made for it and attributes to this the slowness of the conversion of the agriculturist in the Punjab to scientific methods of agriculture. But there are, in point of fact, two obstacles to the rapid achievement of this object : one the inexperience of the instructor, and the other the absence of an intelligent response on the part of the instructed. The present report contains some evidences of the incompleteness of the grasp of the agricultural staff upon local conditions and the consequent unfruitfulness of experiments. To say this is to make no reflection upon the staff. Knowledge is only to be gained by the process of experiment and failure : and the mistake is to expect considerable results from a department which is not yet in its teens. Considering the natural conservatism of the peasant everywhere, and of the Indian peasant in particular, Mr. Maynard thinks it a surprising thing that so young a department, subject to the inevitable failures of the early experimental stage, and still groping after knowledge, should have succeeded in establishing even that measure of local confidence which has been attained. That men who have come half-way across the world to a new climate and new conditions should be teaching the local farmer his business within a decade of their arrival would be a more than human achievement. Comparison with countries such as the United States of America is inappropriate. There the farmer, highly educated and intensely enterprising, accepts and indeed demands " scientific research experiments and demonstration work " directly affecting him. It is within Mr. Maynard's knowledge that he often co-operates with his Government by recording and communicating observations and the results of experiments. In this country he neither demands nor at present accepts what is offered, and the true position appears to be that the provision which Government has made is, in some respects at all events, and notably in the department of agricultural education, ahead of the times. This is not the same thing as to say that further outlay on appropriate objects will not be undertaken : and Mr. Maynard has no doubt at all that Government will be prepared to consider with sympathy every project of improvement which can be satisfactorily justified.

2. The progress of a department of this kind, which has, at the same time, something to learn and much to teach, can hardly be measured by the intervals between annual reports : but no one whose memories of the Punjab travel back for a generation can fail to find matter for optimistic reflection in some of the facts recorded in this report. That there should be places in which men will accept the seed provided by the department without seeing in the offer a deep design for their undoing, that over a thousand ploughs and three or four hundred other agricultural implements of novel pattern should have been bought by zamindars within five years, that 75 reapers (each reaping wheat at a cost of Re. 1-8-0 instead of Rs. 5 to Rs. 7-8-0 per acre) should have been in use during the past years' harvests, that the services of well-borers should have been even in one village so much appreciated as to cause the villagers to make a voluntary present to their helper, and that agricultural associations each containing from 50 to 70 intelligent landowners and cultivators should be actually discussing and working at improved methods would be strange reading to Englishmen who had seen the last of the

Province in the early eighties; and the change is the more remarkable that it is the work of the past few years only. It is only a beginning perhaps, but it is a beginning full of promise: and Government and the Agricultural Department may reasonably be content with their shares in the making of it. That the former has not neglected the call for development during the past year is sufficiently shown by the creation of the new posts of Agricultural Engineer and a third Deputy Director of Agriculture.

3. The education of the farmer depends in a large measure upon effective demonstration of improved methods. It is very gratifying that Mr. Hamilton should be able to describe the agricultural associations as efficient instruments for demonstrating and extending improved methods of agriculture. Co-operative credit societies are not regarded by him as equally efficient agencies for this purpose, presumably because they are made up so largely of men whose properties are too small to give them a lively interest in improvements. But the Financial Commissioner trusts that neither Mr. Hamilton nor Mr. Langley will despair of being able to make co-operation in agriculture, and in the marketing of produce, a pendant to co-operation in credit. In a country of peasant proprietors and small holdings such as the Punjab it is in this direction certainly that the best hope of progress lies.

4. That very little is said in the report on the important subject of demonstration to visitors must not be understood as implying that the matter has been neglected; and the Financial Commissioner is aware that the Director of Agriculture attaches first class importance to this branch of the work. A weak point in the arrangements at Gurdaspur is noted by Munshi Fateh-ud-din, officiating Deputy Director of Agriculture, who points out that there is a difficulty about the housing of visitors. Something in the nature of the "zailghar," which is often erected at district head-quarters for the accommodation of District Board members and the like, is what appears to be required, and Mr. Maynard has little doubt that the money for such a building will be forthcoming when asked for. Something similar will also be required at Basal, when the dry farming experiments there have gone far enough to justify demonstration.

The college.

5. When the Agricultural College at Lyallpur was started it was in the hope that the sons of agriculturists would flock to it with a view to receiving training which they should apply in their own walk of life, and both the Financial Commissioner and the Lieutenant-Governor were reluctant to accept the statement made in the report for 1911-12 that the object of the college was to turn out the scientific and not the practical farmer. But it cannot be said that these hopes show any promise of fulfilment, and they may be said to have been laid aside by the Board of Agriculture when it resolved that such colleges must be regarded primarily as training places for members of the Agricultural Department. In consequence of that resolution, the Local Government has sanctioned in place of the old three years' course the adoption of a two years' course of a simplified and practical kind to which a further and more advanced course of two more years will be added for those students who desire to pursue their studies to a more highly scientific stage. The first of these courses is intended to qualify for subordinate posts in the Agricultural Department as well as for such positions as that of Estate Manager. The Director of Agriculture observes that the existing prospects of the department do not afford sufficient attractions, with the result that the class has opened with 11 students only, of whom it appears from the Principal's report that only two are first-year students. The Financial Commissioner has submitted proposals for improving the prospects of the department, recognising frankly that it is only by so doing that the tender plant of agricultural education can be acclimatised.

The vernacular course which lasts for six months, and is intended to give practical manual training in the use of improved implements, is attended by the sons of genuine agriculturists, and the Financial Commissioner has hopes that this course which has been introduced as a side issue may ultimately prove to be one of the most practically important branches of the department's operations.

Research and experiment.

6. Important investigations by the Agricultural Chemist are in progress; but early conclusions in such matters are not to be looked for. Nothing new is reported as regards varieties of wheat. There appear to be considerable stocks of well established kinds available for distribution, and the spread of these varieties through the agency of co-operative credit societies is in the best interests both of the agricultural development of the Province and of the societies. The report is again silent on the home market values of selected red wheat to which the Director's attention has been drawn in two successive reviews of his report. Mr. Maynard will be glad to have proposals for the compensation in some form of the gentleman whose stock of wheat seed was washed away by flood in Gurdaspur, if (as is, he understands, the case) his only reason for retaining so large a stock for so long was that he might be able to distribute good seed to the members of his bank.

Cotton.

7. It was unfortunate that a large quantity of cotton seed was supplied to cultivators of a type that proved particularly liable to be affected by jassids. Compensation was awarded to the chief sufferers, but it is to be feared that confidence in the department must have been shaken. Another type of American cotton is, however, doing well. The standardisation of indigenous varieties is proceeding. As regards the Director of Agriculture's difficulty in finding a ginning factory to undertake the ginning of its seed, the Financial Commissioner will be prepared to consider a proposal to make a special condition with the lessees of the factories which will shortly be established on the new canals of the Triple Project. On the subject of cotton the Financial Commissioner observes that the statement that Government have agreed to lease 7,500 acres on the Lower Bari Doab to the Imperial Federation of Cotton Spinners is premature, though there is little doubt that the application will be favourably considered.

Cane.

8. Experiment appears to indicate that the removal of "dead hearts" is the most successful way of combating the cane borer.

Miscellaneous.

9. Progress has been made in sericulture and an attempt made to interest in the subject the pupils of primary schools in the district where silk-worms are reared. Progress has been made with olive culture in the Salt Range. A practical expert in bee-keeping is now in receipt of an allowance from Government. Imported strains of poultry appear to have failed, and the Director does not speak hopefully of the department as a means of development in this direction. The project of converting locally the large quantity of bones which is now exported to Europe (especially to Germany) is one of much interest and potential advantage to the Province.

Some of the experiments reported by the Professor of Agriculture (for instance, those recorded in statements XIV and XV showing experiments with calcium nitrate and sodium nitrate on wheat) exhibit clearly the financial results. Mr. Maynard thinks that the working-out of financial results may with great advantage be carried further, *e.g.*, in statements Nos. V, VI, VII, VIII, IX and X, where the outturn of particular crops, unmanured and manured with particular fertilisers, is shown. What it is really desired to know in these cases is whether a particular outlay justifies itself by results. The results of the sacrifice of a crop involved in green manuring might with advantage be similarly illustrated.

Demonstrations.

10. The popularisation of improved agricultural implements proceeds as rapidly as could be expected in the conditions. The Director of Agriculture observes that we want vastly more demonstrators. But unofficial agencies, such as that of the agricultural associations which serve, as it were, as interpreters between the department and the people, are potentially of the greatest value in this respect. The Financial Commissioner feels that the example of the Behar cane rollers shows that an implement which really meets the require-

ments of the people in cost as well as utility cannot fail to meet with ultimate appreciation: and the best demonstrator is a cultivator who has himself used an implement *and found it profitable* at the end of the year. It would be interesting to know the number of implements sold in the districts in which Agricultural Assistants are posted. The Director professes himself disappointed in his attempt to elicit outside criticism of the work of the department in the shape of notes from the Deputy Commissioners of these districts. They are hard-worked officers, with many things to do, and possibly somewhat diffident of expressing opinions on paper with reference to agricultural matters of which their knowledge is general only. But the Financial Commissioner is confident that personal intercourse between the Director of Agriculture and them will often elicit the fruitful criticisms which he desires.

Agricultural Engineering.

11. The Financial Commissioner is glad to notice an improvement in the results of well boring. Mr. Maynard understands that it is the impression of Government that the well borers are not fully employed: but his own experience of attempting to secure their services for a particular locality bears out the conclusion of the report that they are now much in demand. There is a satisfactory outturn of 176 successful borings. The appointment of an Agricultural Engineer has strengthened the department in a very important particular.

Research.

12. The Director of Agriculture observes that none of our Indian assistants has yet shown himself competent for original research, and we are not likely to find an Indian who can take the initiative in research for many years yet. The conception of study by experiment has been for so many centuries in complete abeyance in India, and so universally replaced by book learning as the unique form of scholarship, that the discovery of any general scientific aptitude within a few years of the first circulation of scientific methods would be an unexpected phenomenon. It is sufficient to deprecate hasty conclusions on the subject.

13. This is Mr. Hamilton's last annual report as Director of Agriculture, an office which he has filled with zeal and success since 18th March 1911. Mr. Maynard takes this opportunity of acknowledging the acute intelligence and penetrating criticism which he has brought to bear upon every question, and the profound interest which he has taken in all matters affecting the progress of the department.

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ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB,

FOR THE YEAR ENDING 30TH JUNE 1914.

Staff.

1. During the year the staff of the department has been increased by the arrival from England in December of our 2nd Deputy Director S. Darshan Singh. He has been under training since then and will soon take over charge of the new Hansi Farm and the agricultural work in the south eastern districts. Mr. Millar Brownlie, Municipal Engineer of Amritsar, has accepted the post of agricultural engineer and will take over his duties in December or January. I have promoted M. Charan Singh, an agricultural assistant who had shown administrative capacity as manager of the Gurdaspur farm, to the vacant post of assistant director. Otherwise there have been no permanent changes of importance. Leave however has again deprived us during the present hot weather of both our Deputy Director and our Economic Botanist, whose posts have had to be filled up from the provincial service as Pusa could not supply supernumeraries to act for them. There is no question more urgent than the provision of an adequate leave reserve of European experts, without which our work will be checked in one or other branch almost every year, and I have asked the local government to represent this to the Government of India.

Pay of the department.

2. I sent up a scheme in the end of last October for improving the pay of the assistant directors, research assistants and agricultural assistants and for somewhat increasing the cadre, but no orders have yet been passed. We need many more trained assistants, and the only way to get them is to make the pay high enough to attract really first class men to the college.

Season.

3. The year has been an unfortunate one for our farms agriculturally. The natural conditions were favourable for the kharif crop, and the cotton crop was a bumper one and our sugarcane at Lyallpur was exceptionally good. But our best variety of American cotton, which in addition to a considerable area on the farm occupied 400 acres in the Lyallpur district, was very severely damaged by an attack of jassids. The barani wheat at Gurdaspur suffered terribly from white ants during the dry period from sowing to the middle of December, and at one time it looked as if there would be no crop at all. Heavy rain and wind in March and April caused all our well irrigated wheat at Gurdaspur to lodge, and what promised to be a bumper crop was almost totally destroyed. Owing to shortage of canal water the wheat sowings were very late both at Lyallpur and Sargodha. A very violent hail-storm on March 2nd had its path over part of the Lyallpur farm, did some damage in the botanical area and wiped out the wheat in several of the tenants' holdings. Frequent rain in April and May delayed harvesting operations everywhere. So the results of the experimental work are particularly small.

The college.

4. I need add little to the Principal's report. As was laid down at the recent board of agriculture the college must be regarded primarily as a training place for members of the department. If it were not that we must get well educated and well trained recruits for the department we might close the college to-morrow. As it is, we must keep it open and do all we can to attract students : for if we cannot attract students the department will collapse. I had hoped that orders improving the prospects of the agricultural assistants etc. would have been received

before the present session began (July 20th), but, as noted in paragraph 2, these were not received and the result is that the college class has opened with 11 students only. A small class will furnish still fewer recruits, for some do not want employment and some are unfit. This year out of 9 students who obtained their diplomas I have been able to obtain only 2 recruits.

The new prospectus of the college and the syllabus of the two year course have been drawn up and a summary of them has been published in the newspapers in the hope of attracting men to the college. They are on their way to government through the ordinary official channels.

Vernacular class (paragraph 4 of appendix I).

5. As noted by the Principal, the men and boys who attended the vernacular class were of a fairly good type, but we had not nearly enough of them. For this year's class, which begins in October, we are trying to induce zemindari co-operative societies to send boys. The Registrar of Co-operative Credit Societies is also assisting with a scheme to train men in this class who will then be employed by societies as Agricultural Sub-Inspectors.

Thanks are due to Sheikh Riaz Hussain of the Multan district who has given a scholarship for a Multani boy. During the year there has been correspondence regarding the scholarships granted by government for this class. I hoped government would agree that the class should be free except for journey expenses and a monthly charge for food, but they have seen their way to sanctioning only 6 scholarships in all.

Research and experiment.
(1) Wheat.

6. As to varieties of wheat nothing new has emerged during the year. Punjab type 11 remains our best irrigated white (sharbati) wheat, and Punjab types 13 and 14 are our best red barani wheats, which do well also under irrigation. Type 13 is a late wheat, which is objectionable, as the ripening period is hurried ; but it has done specially well in the Bet lands of the Gurdaspur district. Type 14 is the wheat most commonly approved by the cultivators. It has also given the best yields on the Gurdaspur farm this year. Pusa 12 is a fine wheat to look at, the yields are fairly good and the cultivators are attracted by it, and so the area under it can be rapidly extended. It can be grown either with or without irrigation.

What we seem to need most in the Punjab is a variety of wheat with much stonger straw than any we are now growing. (Type No. 9 had good straw but that had to be discarded for other reasons). We lost the whole of our irrigated wheat at Gurdaspur this year owing to its lodging ; year after year the manured wheat at Lyallpur lodges.

Punjab type No 11 is being grown on the Sargodha seed farm and on private seed farms (about 380 acres) in the Lyallpur district. The yield at Sargodha is given in paragraph 25 : in the seed farms of Lyallpur the yield was about 5,600 maunds, two-thirds of which is available for seed this year. In Gurdaspur, Jullundur and Hoshiarpur types 13 and 14 and Pusa 12 have been grown in the same way, and we have available about 400 maunds of 13, 400 maunds of 14 and 350 maunds of Pusa 12 for seed. A large quantity of this will be grown by members of co-operative banks on seed farm conditions and the rest will be sold outright to cultivators.

The matter of the effect of irrigation on the consistency and nitrogen percentage of wheat, referred to in paragraph 7 of last year's report, is still under investigation. No conclusive evidence has yet been obtained.

A survey was made of the wheats of the Hissar district. Types 10 to 12 (white) and 14 and 15 (red) appear to prevail throughout the district.

(2) Cotton.

7. *American cotton.*—The most important event of 1913 was the disaster which overtook the large area of American cotton of type 3 F which was being grown on seed farms. The damage done to this crop by jassids was very great and was all the more noticeable as other cotton throughout the Lyallpur district was, even in neighbouring fields, specially good. As Mr. Arno Schmidt notes in his report on "Indian Cotton"—"Undoubtedly

the confidence which the department of Agriculture enjoys among the cultivators has been somewhat shaken by this unforeseen occurrence, but if compensation is given to those who were supplied with seed, the confidence will soon be restored ". Government has sanctioned the payment of compensation only to those growers whose crops were very poor indeed. We have at any rate learned the lesson that smooth leaved types must be avoided. Type 3 F has all been discarded.

We are now relying on American cotton 4 F (lint percentage 13 seers) which is doing well. Just over 400 maunds of seed (enough for about 2,600 acres) were issued or sold by the department in the spring, and it has been sown mostly on seed farm conditions, *i.e*, the cotton will be ginned by the department or under the supervision of the Professor of Agriculture and the seed sold to us. The whole of this is in the Lyallpur district and on the Lower Jhelum canal. Last year some 15,000 bales of American cotton were produced round Lyallpur, Sargodha and Jhang ; but unfortunately the cotton is badly mixed with country cotton, which spoils the quality and price. Most of the mixing takes place in the ginning factories. The seed of American cotton is so different from country seed that there is no excuse for the zemindars sowing a mixture. 4 F American cotton, sold in January through the department, fetched Rs. 9-10-0 a maund when *desi* was at Rs. 6-13-0, but private sellers earlier in the season did not get a good premium. I fear the war must entail a slump in the price of cotton and the American cotton will feel the fall most acutely.

Indigenous cottons.—Paragraph 3 of Appendix III shows that three types of *G. neglectum* and *Indicum* (Hansi cotton, so called) have at last been got on to a field scale ; after two or three years' trial on our experimental farms we shall be in a position to decide whether any of them is better than the mixtures grown by the ordinary cultivator and to begin seed distribution if they are.

Appendix V, paragraph 13.

As the Professor of Agriculture states, *G. sanguineum* with broad leaf is being grown on considerable areas on the farm This is a heavy yielding cotton with a short and rough staple and a lint percentage of 12 seers and 10 chitaks which is largely grown in the south west of the province. We had 90 acres of *G. sanguineum* (mixed broad and narrow leaf) grown on seed farm conditions in 1913, and this year 148 maunds of seed have been sold, mostly on seed farm conditions. The issue of the broad leaved variety of this cotton will be pressed on in the southern parts of the Lyallpur district. It would be suitable for the neighbouring districts too.

Cotton survey.

8. The cottons of the Hissar and Lahore districts were surveyed in the field in the autumn of 1913 with the following results :—

Hissar.—In the Hissar, Hansi and Fatehabad tahsils ⅔ths of the cotton is yellow flowered *G. indicum* and ¼ to ⅓ is white flowered *G. neglectum.* White flowered *Indicum* and yellow flowered *neglectum* are also common. There is no *Gossypium sanguineum.* Cotton is unimportant in Bhiwani and Sirsa tahsils.

Lahore.—Yellow-flowered *G. Indicum* represents 74 per cent in Chunian, 78 per cent in Kasur and 91 per cent in Lahore tahsil. In Chunian about 10 per cent is yellow flowered *G. neglectum* ; in Kasur there is a good deal of broad-leaved *G. sanguineum* in canal irrigated villages.

Cotton farms.

9. A lease of 3,000 acres on the Lower Bari Doab canal has been given to Mr. Conville, late of Volkart Bros., on condition that he grows 400 acres of American cotton every year for seed and also grows other seed for the department.

Government have also agreed to lease 7,500 acres on the same canal to the Imperial Federation of Cotton Spinners on condition that they use the land as a model plantation of American cotton. The company to farm this land was to be an international one, and its formation has been interfered with by the outbreak of war.

The grant of these two leases should result in much profit for the cultivators. A supply of good American seed pure of admixture should be secured and there will be factories at hand ready to buy the American cotton at a considerable premium over the price of country cotton. It will be for the agricultural department to see that by constant fresh issue of seed from our experimental farms the quality and purity of the cotton are maintained and the yield and the percentage of lint are not allowed to fall. The lessees will be working to the same end by selection on their own lands.

Manures.

10. The manurial experiments which are being carried on are mentioned in appendix V paragraphs 2—4, 9, 10 and 14, and appendix VI paragraphs 18 and 22. So far no artificial manure can be used profitably. Green manuring with sann hemp has been very profitable on the Lyallpur farm It was also practised in 17 places in the Lyallpur district. A special leaflet containing full directions has been issued. The difficulty in getting cultivators to practise green manuring is that given in paragraph 12 of my report last year. If nitrogen fixation goes on at a more rapid rate in Indian soils than in England then green manuring will probably prove more economical than artificial nitrates.

Paragraph 8 of Appendix II.

This bears directly on a proposal made by Captain Battye, R. E., at the Engineering Conference at Lahore for the manufacture of nitrates with electricity generated on canal falls. The Agricultural Chemist and the Professor of Agriculture both spoke at the conference and pointed out that the scheme was not likely to be profitable both for the reason given above, and also because even if the nitrates could be produced cheap enough, say, Rs. 5 a maund, it is doubtful whether it is not artificial phosphates of which the Punjab soils are in need rather than artificial nitrates.

The manurial value of the phosphatic nodules* found in the Salt Range is being investigated, but further trial is necessary.

The present seems a suitable time at which to endeavour to convert locally the large quantity of bones which are now exported to Europe (especially to Germany) into manure. The Agricultural Chemist is taking this matter up.

Chemical research.

11. The work in progress is mentioned in appendix II. Chemical research is lagging behind, and moreover there is much additional work which cannot even be attempted, such as the feeding value of the fodder supplies of the province, the oilseeds of the province, their value and the storage of them for export, the nitrogen value of Punjab soils, the determination of the factors contributing to strength and consistency in wheat, until we have a second European chemist. I have accordingly asked for the appointment of an assistant agricultural chemist, but orders have not yet been passed. We cannot advance safely in the art of agriculture except on a foundation securely laid on chemical analysis, and this foundation is laid too slowly with only one agricultural chemist who is moreover also Principal of the college. None of our Indian assistants has yet shewed himself competent for original research, nor are we likely to find an Indian who can take the initiative in research for many years yet.

Steam ploughing.
Appendix II, paragraph 6.

12. The use of a mole plough for washing kallar from the soil will also provide valuable agricultural experience as to the economy of steam ploughing in the Punjab. A lease of 2,000 acres on the Lower Bari Doab Canal has been given to S. Jogendra Singh of the Kheri district in the United Provinces on condition that he cultivates the land by Fowler's double engine system of steam ploughing. Messrs. Fowler's representative in India is keenly interested in the success of the experiment, and will keep the tackle in working order for

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*Total phosphate (as P_2O_5) soluble in strong sulphuric acid 19·83 per cent. Available phosphoric acid (as P_2O_5), *i.e.*, soluble in 2 per cent. citric acid 6·6 per cent.

12 months. The Deputy Director will also supervise. So here we should be able to test steam ploughing thoroughly at no cost to government. The plant has arrived.

Botany.

13. The botanical work has not yet reached many results. Appendix III is a record of agricultural operations rather than of botanical research.

Date-palms.
Appendix III, paragraph 8.

14. I have nothing to add to what I said last year. Most of the dates have been rotted on the trees this year by the rain and have fallen off. The crop is much less than we expected. The dates are being cured, some will be sold, and others distributed as samples. An assistant has gone to Basra to buy suckers. Mr. Milne's pamphlet has been widely distributed.

Entomology.

15. We are fortunate in having been lent the services of Mr. Grove, the supernumerary Imperial entomologist, during most of the year. His presence and the methods and results of his work have shewn how necessary it is that we should have a permanent European entomologist in the department, and I have asked for the creation of the appointment of entomologist. Mr. Grove has spent most of his time on the investigation of weevil in wheat: he will publish his results during the cold weather. Some kinds of weevil appear to be possessed of extraordinary vitality. He has also taken up the investigation of the different kinds of borers in sugarcane, but has been able to do little in this as the collections of affected canes sent in from districts more often than not contained no borers. The practical work of preventing damage by borers is described in appendix IV.

Some further investigations into the exact methods of the attack of the bollworm parasite (*Rhogas Lefroyi*) on the bollworm were planned for this hot weather: but owing to the scarcity of bollworm and the complete absence of the parasite nothing could be done.

For the general entomological work appendix IV may be referred to. The hot weather of 1913 saw many more locusts in the Punjab than usual. Energetic measures were taken for their destruction with considerable success.

Sericulture.

16. Paragraph 3 of appendix IV shews that out of the 136 ounces of French silk worm seed issued by the department, 110 ounces yielded 23½ maunds of dry cocoons, which is better than last year's results of 8 maunds from 44½ ounces of seed.

But there is still a great deal of room for advance. As I noted in last year's report I had hoped to sell 150 ounces of seed this year, but at the last moment the zemindars who had reared with great success in the Rupar and Kasur tahsils and elsewhere in 1913 refused to take seed. The reason was that they were men of substance, and the Rs. 30 or Rs. 40 which they could earn was not worth to them the trouble of collecting mulberry leaves.

For the small zemindars and kamins of the submontane tracts there is good money to be made with little risk, and I hope the efforts of the deputy commissioners of these districts and of the assistant professor of entomology will secure rearers of the 170 ounces of seed which I have ordered from France.

The Salvation Army reared 2 ounces of seed in Lahore, 8 ounces in the serai at Changa Manga and 10 ounces in a small Salvation Army school there and with people round about. The 8 ounces in the serai yielded only 2 maunds of dry cocoons, and the 10 ounces outside were mostly destroyed by ants and rats. The results in the serai are disappointing. I saw the worms myself in the last week of March, and they were then well grown in the 3rd and 4th moults. A sudden rise of temperature shortly afterwards spoiled the rearing.

The Kalsia State reared 7 ounces at Chachrauli, but got only 43 sers of cocoons. Their failure adds one more instance of the impossibility of rearing worms in quantity without very complete organization. The worms here occupied the whole of a large bungalow and part of another and bullocks were constantly carting in leaves, and yet when I saw the worms they were crowded and starving. Sheikh Ghulam Sadik arranged, as usual, for the rearings in most of the Gurdaspur district. He gave out 340 ounces of seed and got back 55 maunds of cocoons. The results are much better than in previous years, and I hope the rearers are beginning to learn the necessity of space, cleanliness and abundance of food in the later stages.

I had an attractive object lesson card on sericulture prepared and supplied it to a number of primary schools in the districts of Gurdaspur, Ambala, Sialkot, Lahore, Hoshiarpur and Amritsar, in which silk worms were reared this year. Some of these schools turned out extremely large yields—23, 18½, 14¾, 16½, and 16⅛ sers of dry cocoons to the ounce of seed. If the competition to secure prizes is to lead to inflation of results by the inclusion of other people's cocoons with their own rearings the boys will be taught organized cheating instead of learning how to climb trees and devote care and gentleness to the worms in their charge. School-masters should treat the rearings as a sort of nature study and means of character training and secure a proper standard of honour among the boys.

An exhibition of silk cocoons was held in Amritsar, there being no hall large enough in Gurdaspur, on May 29th. Over 23 maunds of cocoons, dry or nearly dry, were exhibited and Rs. 265 were given away in prizes. The weight of cocoons obtained per ounce of seed was as usual very varied running from almost nothing to 18½ seers. A number of primary schools were given good prizes as an encouragement. The quality was better than in previous years. The whole produce was bought by Khan Bahadur Sheikh Ghulam Sadik of Amritsar at prices from Rs. 80 to Rs. 110 per maund. Officers of the Salvation Army were present but did not compete.

Deputy Commissioners of submontane districts have supplied me with maps shewing those villages in which there are 30 or more mulberry trees and the roads with mulberry avenues. These are useful guides to the localities in which worms can be reared. I am sorry to say little has been done to put down bush mulberry.

Apiculture.

17. Mr. Cousins, lately a military departmental officer, employed in the Sanawar military asylum, is now in receipt of an allowance from Government as a practical expert in bee keeping. He has had long experience in keeping bees, and has at present 16 hives at Sanawar. He is prepared to take European or Indian bee keepers as apprentices. He can supply frame hives suitable for Indian conditions and also swarms in the season. He is ready to advise any beekeeper who will write to him. A movement is on foot to resuscitate the Simla bee keepers association which survived its birth a few years ago for a very short time.

The designing and practical testing of a suitable wall hive for Indian villagers and the surmounting of the difficulty of inducing *Apis indica* to work in the section supers are the two most important problems on which Mr. Cousins is engaged.

Olives.

18. As to the olives in the Salt Range I quote extracts from a note by Mr. F. J. Mitchell who is directing them.

Since last year's report was written the experimental work in the Shahpore district and at Sakesar has been handed over to the Deputy Commissioner and no report of progress has reached me.

At Khairi Murat for the first time the appearance of fruit (on 29 trees) has to be recorded. In July it was estimated that some 5,500 berries should ripen, but since then a storm has shaken off some of these. The remainder are being collected and pickled as they reach a sufficient state of maturity, and will give some idea of the quality of fruit to be expected in future.

The number of grafted trees in the garden has now been increased to 12,787 and 43 acres more have been cleared and put in order. The number of gumlas have been increased by 146 "pucka" and 63 "kutcha".

In vacant spaces 266 young grafted trees from the nurseries have been planted out and further vacancies have been filled with wild seedlings to the number of 800, which will be grafted as soon as they are ready. Scions were brought successfully from Gurhi of varieties which have given good results there, and the trees so grafted are included in the number above given.

In Gandalla Sultan mali has worked very steadily, and there are now 1,250 grafted trees in the rukh. Compared with the grafting done at Khairi Murat this result seems poor, but it is only what is to be expected in starting a new garden. The scions available are either immature or have been carried long distances and the proportion of successes to failures is very small compared with those obtained when grafting with mature scions freshly cut locally.

* * * * *

The 34 imported trees, which were originally planted in the Chuya gardens and used while there as scions, have been removed and replanted in suitable sites in Gandalla. In the absence of grafted plants vacant spaces have been filled with seedlings which will be grafted as soon as they are sufficiently established. Round practically all grafted plants "gumlas" have been made to conserve the rainfall. The soil in the lower parts of the rukh is excellent but very deep and porous; and the watering of individual plants, as now arranged, seems the only method possible of enabling the earlier stages of tree growth to be got through in reasonable time. Once the trees get their roots down to permanent water the growth will be rapid, but even trees with such enormous power of root growth as olives require assistance in establishing themselves if much time is not to be lost.

* * * * *

The almond nursery so far has been successful From one maund of seed nearly 15,000 seedlings came up, and these are now three to four feet high. It was a great disappointment when, on the arrival of 500 young almond trees from Kashmir, only 25 were found to be grafted plants. The Director of Horticulture in Kashmir says that the others are of good soft shelled varieties, but it seems doubtful if we may trust them as scions. In the end of July 63 seedlings were successfully "flute" grafted from the few reliable varieties, and next year it is hoped the grafting may be completed. To do this it may be necessary to import further grafted trees. The loss of time is most unfortunate.

The total expenditure to date has been Rs. 12,417.

Smyrna figs.

19. The Smyrna figs are not fruiting satisfactorily. The method of fertilization has not yet been fully investigated.

Poultry, paragraph 18 of appendix V.

20. There is little to record regarding departmental poultry this year. Having failed with imported strains, an attempt will now be made to improve indigenous breeds and a few birds will be kept at all our farms. Our officers are not however expert poultry farmers, and I think poultry breeding can be promoted more successfully by Government by means of land concessions to private rearers, and by the provision of prizes at poultry shows than by directly managed poultry farms.

The following is an extract of a note on the poultry in the Lahore zoo sent me by the Deputy Commissioner of Lahore:—

* * * * * * * *

There are 55 hens of the following breeds:—Minorcas, Buff Orpingtons, White Orpingtons, Langshans, Indian Game and country bred.

The demand for eggs for purposes of setting was not so great as in previous years, and only 31 settings were called for. The demand for adult birds was greater.

Out of the 160 chickens hatched last year, small-pox and tick fever claimed over half this number.

The income fell below the expenditure, the former being Rs. 402 and the latter Rs. 440; this includes one keeper on Rs. 10 per month.

* * * * * * * *

In the spring of 1914, 175 chicks were hatched, of which there are at present 137; their ages range from four months to six weeks. These mostly consist of cross-breeds, *viz.*, Indian Game and Langshans and Faverolle-Houdans. They all promise well, but it is too early to form an opinion. The results of these crossings will be reported next year.

Sale of implements.

21. Sales of ploughs and other implements have continued at about the same rate as before. I do not understand why more zemindars do not buy the Raja plough. Everyone who has used it long enough to get over the initial trouble with the bullocks entirely approves of it, especially in *bet* lands and other tracts where the land rapidly becomes overgrown with grass. The number of modern implements of all sorts bought by zemindars, military horse-breeding, grass and dairy farms and district boards (but excluding departments of Government) from 1909-10 to April 1914 is as follows:—

Raja reapers and mowers	186	(153 by zemindars).
Raja ploughs	581	
Meston ploughs (Ransomes Sims and Jefferies)	413	
Other ploughs	some 30	
Spring tined harrows	156	(only 68 by zemindars).
Hoes of sorts	61	
Fodder cutters	243	(225 by zemindars).

It is very slow work the popularizing of ploughs, and we want vastly more demonstrators on it.

Reapers.

22. Before harvest 100 reapers in the Lyallpur district and 24 in other districts (chiefly the Chunian tahsil and the Gujranwala district) were visited and thoroughly overhauled. During harvest 75 reapers were again seen at work. Altogether about 100 reapers were used on this year's wheat. In the Lyallpur district the average area cut by a reaper was 60 acres. With a reaper the cost of reaping an acre of wheat is about Re. 1-8-0, whereas by hand the cost is Rs. 5 to Rs. 7-8-0. It is undoubtedly a most economical machine in canal irrigated tracts. Where reapers are not used the causes are usually—

(1) The wheat is lodged;

(2) Several owners own one reaper and they cannot agree who is to pay for repairs;

(3) The tenants refuse to use the reaper because they cannot bring in their friends to earn a bundle a day for reaping, and there is less gleaning;

(4) The owner has no bullocks of his own, and the tenants' bullocks are not strong enough for the undoubtedly heavy work of reaping.

Threhers.

23. Three threshers were worked this year and they were certainly not successful. All the threshers are portable threshers of one type by Ransomes Sims and Jefferies.

(1) 48″ thresher at and near Lyallpur: only 1,661 maunds of grain were turned out. The output seldom exceeded 10 maunds an hour. A good deal of breakage of grain occurred.

(2) 30″ thresher at and near Gurdaspur. Cost of threshing with machine 7½ annas a maund. Average output of dressed grain 7 maunds an hour. Charge made 2 annas the maund. The grain was clean, well dressed and no breakage, but the bhusa was coarse and disliked. The zemindars will not pay more than 4 annas the maund for threshing.

(3) 30″ thresher near Gangapur in the Lyallpur district.

Threshers will be economical only in tracts where the bullocks are urgently required at threshing time for other work, as for instance in the Beas Bet where the sowing of rice follows quickly on the cutting of wheat.

Hansi farm.

24. About 200 acres out of the Hansi Bir were taken over in the spring. The land has been partially levelled and laid out. Some 55 acres are now under cotton, mostly pure types of American and country cotton from Lyallpur. Buildings and a road to the farm are urgently needed and we cannot make much use of the farm till we get them. Administrative sanction is awaited.

Sargodha seed farm.

25. This farm consists of 5½ squares of canal irrigated land close to Sargodha town. It is the worst part of a block of 21 squares originally reserved for a seed farm, but afterwards given as a grant to Raja Sir Harnam Singh. We took over the 5½ squares from the Deputy Commissioner in 1913. Fourteen acres are cultivated directly and the rest by tenants. The whole area is used for the production of wheat seed and American cotton seed. There were 23 acres of 4 F. American cotton last kharif, which yielded 142 maunds of seed cotton and 57 maunds of good seed. In the rabi there were 66 acres under wheat of type 11; the net yield after cuttings for fodder and deductions for menials, etc., was 902 maunds. The crop was not very good, though much better than in past years. The income was Rs 3,432, and the expenditure was Rs. 2,184 including Rs. 1,360 initial expenditure on bullocks, implements and furnishings.

Basal farm.

26. We took this farm over in August 1913. The land had not been cultivated before we took it over; there was very little rain after we took it over and so it was impossible to sow any rabi. Part is now under kharif crops. Wheat will be sown this year.

Well-boring.

27. The sanctioned staff consists of 3 supervisors, 20 borers and 20 mates, but only 19 plants have been in use, and one of the borers worked as an apprentice. The pay and prospects of these men are so poor that it is difficult to get good men on the wages offered, who can be depended upon and will stick to their posts. During the year under report 6 men left service or were removed owing to inefficiency and one died. The sanctioned term of appointment ends shortly and I am applying to Government for better pay.

No.	Name of district.	EXISTING AND PROPOSED WELLS.		REMARKS.
		Number of bores.	Successful.	
1	Gurgaon	42	34	
2	Rohtak	22	20	
3	Karnal	27	11	
4	Hoshiarpur	1	1	
5	Jullundur	48	25	
6	Lyallpur	3	3	3 trial borings
7	Gurdaspur	10	2	2 „ „
8	Gujrat	16	3	
9	Sargodha	1	1	1 „ boring } No borers in these districts.
10	Rawalpindi	2	1	2 „ borings
11	Ludhiana	26	20	
12	Ambala	27	9	
13	Ferozepore	26	17	
14	Montgomery	15	5	
15	Sialkot	34	24	
	Total ...	300	176	

The work is going on in 11 districts. It has been stopped in Rohtak and Hoshiarpur. During the year 292 wells were bored and 8 trial borings were made. The supply was increased in 169 wells and 7 trials were successful. The results in the Rewari circle were as usual the best, 71·4 per cent. of the borings being successful.

There has been a keen demand for the services of borers in many districts. The usual difficulty in procuring labour was experienced; and about harvest time many of the borers remained idle for a long time in consequence. At other times deputy commissioners might make more use of their powers of fining under boring rule 16. (Year Book, page 54). The programmes of work have generally been fairly well filled up in advance. There has been some trouble to secure programmes in a few places only, where the operations were undertaken in an unsuitable locality. One failure at the beginning generally means an empty programme in the neighbourhood.

Failure is often due to the owners refusing to allow the bore to be taken deep enough. Elsewhere as in Ambala there is a deep stratum of quick sand (laili or jilhan) which will not let our pipes down.

In Kalaswala in Sialkot our borer was singularly successful and provided a good supply of water in a large number of wells which had been before dry or nearly so. The people were so pleased that they subscribed a considerable sum as a present to the borer. In the Rewari and Jagraon tahsils too success is usual. I wish both deputy commissioners and tahsildars were better acquainted with Molony's "Manual of Irrigation Wells" and with the rules and technical instructions for borers.

District work.

28. The district work in Lyallpur district is under the professor of agriculture and elsewhere under the deputy director and the two assistant directors. Owing to want of staff regular work has been undertaken only in Gurdaspur, Jullundur, Hoshiarpur, Gujrat, the Sargodha colony and indirectly in Sialkot. Hissar and Ferozepore are now being added. Elsewhere occasional demonstrations of implements are given at fairs but they do not go for much. In all districts our methods are similar. Agricultural associations have been formed under the presidentship of the deputy commissioner or the settlement officer with 50 to 70 intelligent land owners and cultivators and sometimes a few officials as members. Every zemindar member is required to carry out some agricultural operation or to use some implement in the way recommended by the department. A few implements are lent free of cost for a year or so to the members who have to give them a trial. After the year they are sold to the member or moved on to some one else. An agricultural assistant is posted to the district and tours round to the members, advising and assisting them. The operations usually prescribed are—

(1) the use of Raja and other ploughs generally and also for special purposes such as breaking up over grown land, hot weather ploughing, sugarcane cultivation ;

(2) sowing of cotton and maize in lines ;

(3) the use of harrows for breaking the crust after rain and for conserving moisture ;

(4) the use of hoes of various sorts for interculture ;

(5) green manuring with sann hemp ;

(6) destruction of moth borer in cane by cutting out affected shoots.

(7) sowing tested varieties of seed.

There are two meetings a year at which the results of the operations undertaken are reported and discussed. Model rules for agricultural associations are given on pages 48 and 49 of the Year Book for 1914.

These associations are doing most useful work and are efficient instruments for demonstrating and extending improved methods of agriculture. Those in Gujrat and Jullundur are not so much interested in the work as the others. We ought to spend a great deal more money on them—lend out more implements, have a demonstration farm somewhere in the district with a school for boys of about 16 attached to it, and have more departmental demonstrators. But there is neither money nor staff.

29. I asked the Deputy Commissioners of the five districts in which there are agricultural associations, and of Sialkot to give me a note on the work of the department in their districts hoping thereby to obtain confirmation of our departmental opinion that some success in the introduction of better implements and methods had been obtained, but if we were not so fortunate, at least to call forth criticism which would enable us to improve our methods and to make more rapid progress in the future. But I am sorry to say that the reports generally miss the mark so widely that they neither encourage us by commendation nor brace us up by merited criticism. One deputy commissioner got my deputy director to write the note for him, which effectually stifled the outside criticism I wanted

Seed multiplication and distribution.

30. I have said something about the varieties and quantities of seed distributed in paragraphs 6 and 7. I will now mention briefly the methods of distribution.

We select large land owners in the tracts for which we consider a variety of seed suitable, and we ask them to grow the seed under our supervision and to agree to sell it to us at harvest at a small premium over the market price, if we consider it suitable for issue as seed. We buy the seed, thoroughly clean it and winnow it and then issue it at a premium calculated to cover the expenses of cleaning.

In selecting our growers of wheat seed we have taken the advice of the Registrar of Co-operative Credit Societies and of his inspectors, and as far as possible chosen presidents of banks or of bank unions. By doing so we hoped to avoid having to purchase the seed and then re-sell it; we hoped that the growers, by their influence with members of the banks, would be able themselves to sell the seed. So far we have been only partially successful. The growers often cannot afford to hold up several hundreds of maunds from harvest time in April till sowing time in October, and we have to step in and buy. Moreover it is extremely difficult for our agricultural assistants to get rapidly round all the growers, decide what crops are fit for seed and see to the proper harvesting, cleaning and storing of the seed. In one case one of our best helpers in the Gurdaspur district, a president of a union bank, was storing 200 maunds of excellent seed for the members of his bank when the floods came in July and washed the whole away—indeed washed the whole village away except a veterinary hospital which he had built at his own expense. These are the sort of catastrophes which are apt to overtake those who work for the public good and which should, I think, be compensated by Government.

In the case of cotton seed the matter is much complicated by the necessity of making departmental arrangements for the separate ginning of all cotton of which the seed is to be used for sowing. We have to arrange with ginning mills to buy the cotton with an agreement to gin under our supervision and to re-sell the seed to us. The details of these arrangements give a great deal of trouble and even then the seed gets mixed. We cannot hire a factory, for gin owners in the Punjab are the sole purchasers of cotton and jealously keep exporting firms, such as Ralli and Volkart, out of the market for seed cotton by refusing to hire them factories. They are equally opposed to hiring a factory to Government, for then Ralli could come in and buy American seed cotton in competition with them and have it ginned in the Government factory. Probably we shall have either to set up a few gins at suitable centres or to persuade the seed growers to do so, as in the Central Provinces. But the main thing is that the seed farms for both wheat and cotton should be owned or controlled by co-operative societies, constituted for the special purpose of seed multiplication and distribution. We cannot use credit societies, for they are not necessarily made up of men much interested in agricultural improvement — in fact the Jat Sikhs who are probably the most go-ahead agriculturists do not take readily to the co-operative credit movement. So separate societies must be formed. Both the Registrar of Co-operative Credit Societies and I have been aware of this for some time, but make shift arrangements are being continued till the people are familiarized with the idea of co-operation in seed production and distribution. I hope some societies will be formed this year. There should be little difficulty in the case of American cotton for the people recognize the importance of constant renewal of the seed and the maintenance of its purity, and will pay such a large premium that any society will make a cotton seed farm profitable. In the case of wheat there is more difficulty for there is less variation in the price of wheat according to the quality.

Other co-operation in agriculture.

31. A few co-operative banks are stocking Meston ploughs for sale. This practice might be extended greatly, but I think the societies should be separate agricultural societies not banks. There are many other directions in which agricultural co-operative societies might improve the agriculture of their members, and at the same time make a profit—by destruction of pohli (*carthamus oxyacantha*), stacking of chari at harvest time, management of grazing grounds, provision of a bull for members' cows, marketing of cotton. The Registrar of Co-operative Credit Societies has the whole matter under consideration.

I have during the year been pressing on the people, on Deputy Commissioners and on the Financial Commissioner the necessity of the preservation and better maintenance of such village grazing grounds as still remain in the highly cultivated districts of the province. The matter is a standing item in the agenda of agricultural associations. So far little has been achieved, but attention has been drawn to the importance of the question, and I hope the next step will be co-operative action to grow grass in village commons.

The case of the chiragahs in the Chenab colony is special and complicated. I have asked that a committee should sit on it early in the cold weather.

The Financial Commissioner has rejected a proposal that squares on the Lower Bari Doab canal should be allotted to zemindars of a few congested villages in the central districts on condition that the men gave up their holdings in their old villages to be turned into common grazing ground.

32. The conversion of the agriculturist in the Punjab is probably slower than in any other province and the main reason is that money is so scarce. I give some statistics:—

	Cultivated area.	*Expenditure on agriculture excluding Public Works.*
1912-13.	Acres.	Rs.
Punjab	27,736,701	2,60,860
Central Provinces ...	28,817,000	3,69,382
Bombay	39,963,000	7,49,828
Madras	34,682,562	4,34,171
United Provinces ...	38,192,067	6,13,259

So the Punjab spends less than any other similarly situated province In 1913-14 the expenditure was only Rs 2,94,752, although the Imperial Government gave a grant of Rs 1,20,000. Most of that grant has gone in relieving Government of some of the ordinary agricultural expenditure and little has been used for projects which would not otherwise have been undertaken. If we compare our expenditure with that of western countries it is even more clear how far short we are of assisting agriculture on the modern scale. Let us take the United States expenditure of 9 million dollars on "scientific research, experiments, and demonstration work directly affecting the farmer" and compare it with our expenditure of Rs. 1,83,654 on similar objects—

		United States of America.		*Punjab.*	
		Rs.	A.	Rs.	A.
Expenditure per 1,000 rural population	...	560	0	10	6
" " 1,000 acres cultivated	...	58	0	6	10
" " 1,000 rupees worth of crop	...	4	8	0	5

A much more lavish provision is necessary. The chief need is more staff, especially more European staff, and in many cases much higher salaries. For it is through personal research in chemistry and botany, personal inventiveness in the art of agriculture and personal persuasion by the demonstrators that Punjab methods can be improved, and it is on men, good men and many of them, that money must be spent. In addition all forms of demonstration and all forms of elementary agricultural instruction should be entirely free of cost and of risk of loss to the cultivator.

33. Large numbers of officials and zemindars have visited our farms and most of them seem to find something to interest them there. The staff of the department, both officers and rank and file, has worked well throughout the year.

The 3rd September 1914.

W. S. HAMILTON,

Director of Agriculture and Industries, Punjab.

APPENDIX I.

Report of the Principal, Punjab Agricultural College.

THE fifth session of the College commenced on the 20th of July 1913 with a diploma class of 11 and a second year class of 14, making 25 students in all, for the diploma of Licentiate in Agriculture. No student joined the first year class. In the previous May 1913 an entrance scholarship examination was held in which 11 candidates out of 25 applicants presented themselves for examination (see my annual report of last year). Seven scholarships were granted on the result of this examination. In addition to the above 5 students were admitted from 15 applicants for admission as fee-paying students. None of these students joined in July 1913 though one was willing to join in September 1913, consequently no first year class was held during the session.

In addition to the diploma course there was held between the months of October 1913 and May 1914 a vernacular course in practical agriculture. Fifteen students attended this class. A five weeks' course of tuition was given to the Assistant Commissioners' class. This was attended by four Assistant Commissioners, the new Deputy Director of Agriculture Sardar Darshan Singh and the Registration Officer of Grantee Camel Corps, Lyallpur.

In addition two casual students attended the diploma class, making in all 48 students who received instruction in one or other of the above classes during the year.

The college students were classified as follows :—

Hindus	21
Muhammadans	13
Sikhs	9
European officers	5
Total ...	48

2. *Diploma Examination.*—The third diploma examination commenced on the 20th April 1914, 10 candidates presenting themselves for examination. Nine were successful, but no candidate obtained a first class diploma. The general standard of the candidates for the diploma this year was fair. There was, however, no student of outstanding merit as was the case in the two previous examinations and the higher percentage of passes is to be attributed to the lightening of the examination by allowing students to take the examination papers in Mathematics, Physics, Land Revenue and Surveying at the end of the first and second years.

3. *Short vernacular course for sons of zemindars.*—The six months' vernacular course similar to that reported last year was again given to a class of 15 students The students attending this class were superior to those of last year and were I consider an eminently suitable type for the Agricultural College. They were strong and sturdy, of the zemindar class and keen on their work on the farm.

4. *Change in the diploma course in the Punjab Agricultural College.*—The subject of agricultural education which was discussed for all India at the Board of Agriculture held at Coimbatore in December 1913 advised certain modifications and changes in the standard curriculum for Agricultural Colleges in India issued by the fourth Board of Agriculture in 1908. I have consequently drawn up a new syllabus and curriculum for the Punjab Agricultural College which includes the changes recommended by the Board of Agriculture. This new syllabus will come into force from the 20th July 1914. These changes embody the substitution of a four years' course for a three years' course and its division into two parts, the *first part* to consist of agricultural tuition, both practical and theoretical, with such elementary lectures in science as will enable the student more clearly to comprehend the lectures in agriculture. The science lectures are really a part of the agricultural course, though they are delivered by the Professors of Agricultural Chemistry, Botany and Entomology. In addition manual instruction will be given in the college workshop and a simple course in Veterinary Science in the Civil Veterinary Hospital. Tuition will also be given during the two years in English and Arithmetic. I have submitted the details of this new two years' course for the approval of Government. This two years' course will qualify a student for admission into the subordinate ranks of the Agricutural Department as Agricultural Assistant as well as for such posts as Estate Managers, etc.

In addition and in continuation of this First Part a further course of two years will be given for the diploma of Licentiate in Agriculture. In the Second Part systematic lectures will be given in the sciences of Agricultural Chemistry, Botany, Entomology, Veterinary Science, Agricultural Engineering, Land Revenue and more special instruction in agriculture. The qualification for admission to the Second Part of the course will be a first class leaving certificate for the First Part.

5. *Entrance Scholarship Examination,* 1914, *and the admission of students in the Punjab Agricultural College.*—Five nominations for the entrance scholarship examinations were received and four candidates attended. I examined all these students orally myself this year and selected two of them for Government scholarships. I also interviewed on 7th May

1914, 3 students out of 11 applications for ordinary admission and admitted them as suitable for the course. In all 36 applications including nominations for the entrance scholarship examination as noted below have been received for entrance to the college. Thirteen have been admitted, but up to the date of reporting only two students have joined :—

Name of province and division.	Nomination for entrance scholarship.	Applications for admission as ordinary fee-paying students.	Total.
Lahore division	...	5	5
Ambala division	...	6	6
Jullundur division	3	8	11
Multan division	1	4	5
Rawalpindi division	1	3	4
Delhi	...	1	1
United Provinces	...	2	2
North-West Frontier Province	...	1	1
Rajputana	...	1	1
Total ...	5	31	36

6. *College buildings.*—The scheme reported last year for improving the filtered water-supply for the college buildings and farm has been partially completed during the year. One of the main objects for which the improvement was instituted was the supply of adequate filtered water to the college laboratories, and this it has failed to do. The laboratories have been frequently forced to suspend work for want of water. The difficulty is due to the tapping by the municipal authorities of the pipe line laid down by the Agricultural Department for the college in 1908. I am in correspondence with the Executive Engineer, Provincial Division, Lyallpur, and the President, Municipal Committee, Lyallpur, with regard to putting this matter right, but as the latter now claims this pipe line as municipal property, I fear further expenditure will have to be incurred in order to render the college water-supply adequate.

The following works have been undertaken during the year :—

	Rs.	A.	P.
(1) Extension of the museum	975	14	7
(2) Improvement of the laboratory drainage of the college.	717	0	11
(3) Constructing quarters for three assistant professors and four research assistants.	16,797	12	3
(4) Extension of the water-supply of the college	4,127	15	6
(5) Dairy buildings	3,012	6	3

Sanction has also been asked for the construction of residential quarters of the Assistant Professor of Botany at an estimated cost of Rs. 5,368 and for two Research Assistants at an estimated cost of Rs. 4,050.

7. *Workshop and electric plant.*—A breakdown occurred in the electric plant in August 1913 due to a portion of the engine breaking loose and causing considerable damage to the working parts. Repairing charges amounted to Rs. 1,724-7-0.

A scheme has been submitted for the extension of the electric power to meet growing requirements in the laboratories, the college workshop and the dairy as well as to provide lights and fans to the officers' quarters :—

	Rs.	A.	P.
For providing motors	3,595	0	0
For extra plant and mains	11,642	0	0
For providing electric fans and lights in the four residences (for which Government will charge rent).	7,184	0	0
Total ...	22,421	0	0

The gas plant has been overhauled and repaired during the year at a cost of Rs. 360 by Messrs. Mansfield and Sons, the maker of the plant.

8. *Hostel.*—The hostel has been satisfactorily managed by the Assistant Professor of Botany, and the health of the students has on the whole been good. One student was dismissed from the college as he was suffering from an infectious disorder.

9. *Library.*—Two hundred volumes have been added during the year. The library now consists of 8,480 volumes.

10. *Clubs, Societies, etc.*—The College Athletic Club and Science Society have been satisfactory and the assistant staff have taken more interest in the social life of the college than was the case in the previous year.

11. *Expenditure.*—The working expenses of the college during the past year have been as follows :—

	Rs.
Pay of officers and establishment	55,413
Travelling allowance	9,084
Contingencies	46,096
Total ...	1,10,593

The expenditure for the past five years from the opening of the college has been as follows :—

	Rs.
1909-10	95,240
1910-11	90,564
1911-12	92,517
1912-13	98,277
1913-14	1,10,593

12. *Income—*

	Rs.
1909-10	764
1910-11	3,818
1911-12	8,290
1912-13	11,739
1913-14	7,553

The increase during the present year is due to expenditure in connection with the Narwala reh farm

J. H. BARNES,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

Report of the Agricultural Chemist.

1. *Staff.*—There has been a vacancy in the assistant staff of one Research Assistant, no suitable candidate having been forthcoming. One assistant has been under training at Pusa under the Imperial Bacteriologist.

2. *Provincial chemical work.*—During the year 127 samples have been analysed for the department and for private persons. These samples consist of soils, waters, manures, chemicals, beet roots, gur, wheats and other materials.

3. *Investigations.—Sugarcane in the Gurdaspur District.*—The analytical survey of the canes of the Gurdaspur district has been continued during the season 1913-14. 236 samples of canes and 36 samples of gur, shakkar and other country sugar products were analysed for this purpose. The average sucrose contents of the cane juice in the Gurdaspur district was 15·03 per cent. and the invert sugar 0·73 or rather lower than that of the two previous years. In addition to the district samples, a number of varieties of cane grown on the Gurdaspur farm were kept under observation with regard to the variation in sugar contents during the season, and the results of these experiments will be published shortly.

In addition to the cane survey of the Gurdaspur district, experiments have been undertaken during the season at Lyallpur on the ripening of cane. These experiments include a number of investigations into the effect on the sucrose contents of storing cut cane at different temperatures. This work is being carried out by the Punjab University Kapurthala scholar. From these experiments we have been able to deduce the optimum temperature for sucrose formation in the cane stem. The selective power of the pith cells of cane for different sugars has also been studied as well as the sugars and enzymes present in the cane leaf at different periods during the day throughout the winter months. The whole of this work which bears on the problem of the ripening of cane will be extended and repeated during the forthcoming season.

4. *The wheat weevil.*—Experiments have been carried out during the past five months in collaboration with Mr. Grove, Supernumerary Entomologist, in the effect of temperature, moisture and various gases on the three principal weevil pests of wheat, namely *Aethriostoma undulata, Calandra Oryzae, Rhizopertha dominica*. The results so far obtained are not sufficiently conclusive to justify any generalisation, but it appears that *the* stored wheat will have to receive mechanical treatment in order to remove the pest. These experiments are expected to be completed towards the end of 1914.

5. *Canal seepage*—The work on this important subject has been suspended on account of my inability to obtain the services of a competent Physical assistant. It will be taken up during the later part of the summer of 1914.

6. *Reh reclamation experiment at Narwala.*—A piece of land of one hundred and thirty acres in extent situated at Narwala, about 11 miles from Lyallpur, which is badly affected with alkaline salts, has been taken for the purpose of testing a system of sub-soil drainage by machinery combined with washing. The land has been drained with the mole plough, and washing the soil will commence this summer. A good deal of delay has occurred in getting the new canal supply on to the land and so handicapped the progress of work. The central open drain into which the mole drains deliver is not yet complete. The earthwork of the experiment including the water channels and the open drain are being carried out by the Canal Department.

7. *The Kangra Tea Trade.*—A tour has been made in Kangra district with the object of ascertaining the possibility of opening up a trade in tea between the valley of Kangra and Tibet. Kangra tea has been steadily declining in quality for many years owing to the gardens falling into the hands of inexperienced landlords. Considerable amounts of low grade teas find their way down into the Indian market. These tend to lower the name and market value of Kangra teas. These teas are eminently suited for the trade requirements of Central Asia (Tibet), and an effort will be made to manufacture a quantity of brick tea from these and open a trade with some of the principal markets where such teas, which hitherto have been obtained from China, can be sold.

8. *Nitrogen in Punjab soils.*—Some preliminary analyses have been made of the nitrogen contents of Punjab soils. The crops of senji and gram appear responsible for the fixation of much larger quantities of nitrogen than is shown by the pasture land experiments at Rothamstead.

J. H. BARNES,

Agricultural Chemist, Punjab.

APPENDIX III.

Report of the Economic Botanist.

1. *Prefatory.*—Mr. Milne proceeded on six months combined leave on 22nd May and I have been officiating for him since then. The Economic Botanist was occupied with teaching work for the greater part of his time during the year.

2. *Cottons.—General*—There were 12½ acres of land under experimental cottons this year. Ten acres of this were of medium quality of loam and got the usual cultivation and treatment. The remaining 2½ acres were of rather poor quality of soil.

3. *Collection of Indian cottons from the Punjab and North-West Frontier Provinces.*—These cottons occupied about 10 acres of land, as the types which have been separated

in this collection required a good deal of space to enable us to test them further against each other. Some general figures taken from the data got are as follows :—

Name of cotton.	"Kan", *i.e.*, per cent. of fibre in seed cotton.	Length of lint.
G. Neglectum	34% approximately	0·6″–0·8″
Do. var. Rosea	34–38%	0·6″–0·8″
G. Indicum	25–31%	0·7″–0·9″
Do. var. Mollisoni	34–39%	0·6″–0·8″
G. Sanguineum, var. minor	30–33%	0·6″–0·8″

"Kan" is of much more importance in these rough short-stapled cottons than in the case of American cottons. Lints of the most promising selections were sent to Messrs. Tata & Sons, spinners, Bombay, for comparison and valuation. According to their report Nos. 114, 133 and 135 G. Indicum, yellow flowered, and Nos. 20,124 and 27 G. Sanguineum are valued at Rs. 230 to Rs. 240 per candy and can spin up to 16s. The value and spinning counts of a number of other selections are reported below these figures. Ordinary unselected cottons spin 10-14s and are 0·6″ to 0·2″ in length but being mixed are irregular.

Figures of the crops per acre got this year from each of the selections are at hand, but as they have only been grown a single year on ⅛th to ½ acre plots it is premature yet to say what their relative cropping capacities are. The outturns of *kapas* (unginned cotton) were from over 8 maunds per acre on poor lands to over 14 maunds on medium lands.

Varieties of these cottons, *viz* —

G. Neglectum, var. Rosea, No. 87,
G. Indicum, No 135,
Ditto. var. Mollisoni, No. 24,
G. Sanguineum, No. 20 A,

sufficient to sow about 20 acres in all have been handed over to the agricultural section for further testing of their relative cropping powers on larger areas at Hansi and Lyallpur.

Some interesting points in connection with the correlation of gland character among these cottons were discovered last year.

4. *American cottons.*—Only 2½ acres of selections of acclimatised cottons were grown, as there was no room for more owing to the space taken up by the Indian cottons. The outturns have been 7½ to 17½ maunds per acre. No selections have been handed over to the agricultural section for further tests. The lints of these selections have been sent to Messrs. Tata & Sons and the British Cotton Growing Association as usual. Messrs. Tata & Sons value our acclimatised American cottons, Nos. 72, 110, 111, 112, 281, between Rs. 350 and Rs. 330 per candy and remark that they will spin from 40—44s. Selection No. 161 is reported better than middling American and can spin 50s. It has been valued at Rs. 410 per candy (784 lbs.)

Last year when the cottons were grown on very sandy soil the crop was poor and the valuators noticed in nearly all the samples a great irregularity in length and strength of the fibres, which was not noticed in previous years in the selections. This year the lints of a few of the same selections grown on plots of good land have already been valued and the absence of this irregularity has been noted on by Messrs. Tata & Sons, Bombay. The spinning counts are also higher this year than last year. The irregularity in the fibres therefore is apparently due to the sandy soil. Streaks of this sort of soil are to be found in many parts of the Punjab plains and American cottons on these are always miserable. From our own records and from observations of American cottons grown by villagers it is evident that we must not allow farmers to sow cottons on such lands if we do not wish them to be disappointed and the spread of American cotton crops in the province to be checked; also that in judging which cotton of a number of selections is best from our point of view, we must be very careful to take into account the quality of the land on which they were grown. Desi cottons give better results on such soils. The question of the effect of soil on lint is being looked into in various ways. The effect of climate on American cottons is also being looked into.

The tylenchus disease discovered last season to be the cause of the root rot disease is being further studied.

5. *Wheat.*—Small plots of the Punjab classified wheats have been grown as usual in order to keep up a supply of pure seeds of these. The 29 new types of wheat were grown on areas ranging from $\frac{1}{32}$nd to $\frac{1}{16}$th an acre in the botanical area. The Professor of Agriculture very kindly grew 10 of these types and one cross for us on the farm.

The damp weather in January and February produced a greater amount of rust on the wheats than I have ever seen, and a very severe shower of hail in March together with the rust has reduced the crop by about 40 per cent. and ruined the experiments for the year. The Punjab wheats were affected as follows :—

	Least rusted types.	Moderately rusted types.	Most rusted types.
Old types ...	IV, XI, XIII, XVI, XVII, XX, XXI, XXII, XXV.	I, II, III, V, VI, VIII, XII, XIV, XV, XVIII, XXIII, XXIV.	VII, IX, X, XIX.
Newly discovered types ...	VIIIA, VIIIB, IXB, XIXA, XIXB, XIXC, XIXD, XXD, XXIVB.	IXA, IXB, IXC, XVIIA, XVIIB, XVIIC, XVIIIA, XIXG, XIXH, XIXF, XIXE, XXA, XXB, XXC, XXIIIA, XXIVC, XXIVD, XXVA.	XXE, XXVC.

6. *Wheat disease.*—Some diseased wheats in which the heads became more or less gummy and abortive were examined and Nematode worms (tylenchus sp.), closely allied to those causing ear cockle here, were found in the glumes and are apparently a cause of the disease. Further work is being done on the case.

7. *Barleys.*—The collection of Punjab barleys was grown, but the severe hail storm above referred to damaged the crop and grain so badly that neither cropping powers nor malting properties could be tested. The experiment will be repeated next year.

8. *Scotch potatoes.*—Several new varieties of Scotch potatoes were grown at Kufri in the Simla hills. Cultivators are of opinion that they are more disease resistant and better than their local potatoes. Some 60 maunds have been planted this year.

9. *Date palms.*—Date fruits much superior to the ordinary quality of Punjab dates were got from the Muzaffargarh plantation last year. This year about 90 plants are in fruit in the Taleri Bagh, Muzaffargarh, about 50 in the garden of the Central Jail, Multan, and a dozen at Lyallpur.

During the year under report no trees were imported. We hope to get a consignment this summer however. Cultivators, having seen or heard of the Arabian fruits grown in Muzaffargarh, are very keen to get young trees, but much disappointment is sure to result as the people do not yet realise the care necessary in the first few years after planting.

Visits were paid to some of the date-growing parts of the province and advice was given regarding indigenous date trees.

10. *Tobacco parasite.*—At Hazro and the surrounding villages a parasite has appeared on the roots of tobacco plants. It was investigated and found to be Orobanche nicotianæ. The tobacco crop was badly damaged by the parasite and several measures have been suggested to eradicate it.

11. *Miscellaneous.*—Specimens of plants and weeds of field crops were collected, identified and added to the herbarium. Many other plants that came from outside were identified and information regarding the habits and usefulness of these plants was supplied.

JAI CHAND, LUTHRA,

Offg. Economic Botanist, Punjab.

APPENDIX IV.

Report of the Assistant Professor of Entomology.

RESEARCH AND PROVINCIAL WORK.

1. *The cane moth borers.*—Experiments with trap crops and cutting out of "dead hearts" were repeated at Lyallpur and Gurdaspur. The results obtained so far prove that the regular cutting of "dead hearts" is by far the most effective practical measure against all species of shoot-borers in young canes, and it leads to a considerable increase in the yield. At Gurdaspur the yield from dhaulu canes by the "dead hearts" removal method was 34 per cent over those of the adjacent similar in quality trap crop and untreated plots, and at Lyallpur in Kahu canes the increase in yield by this method has been 60 per cent.

Table of the outturn results.

	No. of field.	No. of plot.	Treatment used.	Area harvested.	WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF GUR PER ACRE.		REMARKS.
					Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	
Gurdaspur Dhaulu variety of cane.	4	13	Maize trap crop used successively.	1,574 square yards.	95	37	50	35	7	26	23	21	Yield from plot 11 is 34 per cent. more than from plots 12 and 13.
	do.	12	Untreated	"	90	20	47	20	7	30	23	33	
	do.	11	Regular cutting of dead hearts.	"	128	9	68	0	10	9	31	21	
Lyallpur Kahu variety of cane.	12/17	4	Trap crop of maize and jowar used successively.	Kanals 1 Marlas 13	46	6	28	18	4	11	20	29	Yield from plot 2 is 60 per cent. more than plot 4.
	do.	2	Regular cutting of dead hearts.	1 16½	81	20	49	38	7	30	33	38$\frac{1}{16}$	

This year the removal of "dead hearts" is being carried out on our cane-growing farms and on the plots of some of the members of the Lyallpur, Gurdaspur, Hoshiarpur and Jullundur agricultural associations.

2. *The cotton bollworm.*—Last season the bollworm attack remained much below normal. The permanent parasite breeding plot was kept during winter. Bollworm is not likely to give trouble this season. The early broods have been killed off by rains. Its attack is almost *nil* so far, being hardly 2 per cent.

3. *Sericulture.*—136 ozs. of seed were distributed in the districts of Ambala, Sialkot, Hoshiarpur, Gurdaspur, Gujrat, Amritsar, Lahore, Ludhiana and Attock,—100 ozs. amongst the zemindars and 36 ozs. in suitably situated village primary schools—which were reared on scientific principles under our direct supervision.

Hatchings commenced in the 4th week of February and continued till the middle of March. Seripositing was mostly delayed till the beginning of May owing to—

(1) late incubation of eggs due to absence of mulberry leaf earlier in season;

(2) irregular and late hatchings due to bad and imperfect incubation.

To remove this last serious drawback an incubator, which can hold about 3 ozs. of seed, has been devised and tried at Lyallpur. It gave satisfactory results last year. The complete apparatus would not cost more than Rs. 3, and its working is simple and cheap, costing about 2 pice a day.

Out of the 136 ozs. of seed 10 ozs. were completely destroyed by rats which proved very troublesome throughout last season; the result of 16 ozs. is not available, as their produce has not been sent in yet; the remaining 110 ozs. have yielded 23½ maunds of dry cocoons which were sold to Sh. Ghulam Sadik for Rs. 2,340.

4. *Campaign against the north-west locust* (*Acridium peregrinum oliv.*)—The locusts were bad chiefly from June to October, when regular swarms of them were moving about specially in the districts of Gurgaon, Hissar, Rohtak, Ferozepore, Montgomery, Multan and Muzzaffargarh. In localities where the visitations were bad we worked in co-operation with the local authorities. Spraying the first and second-stage hoppers early in the morning with sanitary fluid (1 pint to 4 gallons of water) proved effectives

Mechanical measures like the trenching and the burning of hoppers were most vigorously carried out, and the result of this concerted action was that although hopper swarms were by no means exterminated, yet they were kept out of the crops which were mostly reaped before the locusts bred on the grass lands had come to maturity.

5. *Aleurodes on oranges.*—In January last at Leiah 308 orange trees badly infested with aleurodes were sprayed with different contact insecticides. Rosin wash has given the best results so far, and one more application of it will be given next winter.

6. *Aleurodes on date palms.*—The date plants in botanical area were severely attacked by aleurodes last October. Two sprayings of rosin wash got rid of the pest.

7. *The senji weevil* (*Hypera variabilis, Hbst*).—It attacks the shoots of senji. It was controlled last winter by the use of bags.

8. *Cut worms* (*Agrotis flammatra, schiff.*).—Cut worms are regular major pests in all young crops from February to April. Light traps were tried last year on the students farm and 2,742 moths were captured.

9. *Epilachna* 28-*punctata, F. and Epilachna dodecastigma, Muls.*—were badly attacking the leaves, stems and joints of brinjal last October. Spraying with lead arsenate proved very useful.

10. *Aphis.*—During winter aphis was bad on toria, radish, cabbage and turnips. It was killed by spraying it with crude oil emulsion (½ pint to 4 gallons of water).

11. *General.*—Study of the injurious insects has been continued and as a result "A preliminary list of the injurious insects of the province" has been compiled.

MADAN MOHAN LAL,

Assistant Professor of Entomology,

Punjab Agricultural College, Lyallpur.

APPENDIX V.

Report of the Professor of Agriculture on the Lyallpur Farm.

1. *Statement I.—Season.*—The rainfall during the year amounted to 16·84″ compared to 9·57″ in the previous year and an average of 12·51″ for the previous five years and of 9·15″ for the previous ten years.

The year was very favourable for sugarcane and cotton, but somewhat more so for *desi* than for American cotton. The smooth leaved type of American cotton, both the old original Dharwar and 3F, of which latter nearly 400 acres were grown, suffered from an attack of jassids in August and September. The great bulk of the American cotton however did very well, yields of 15 to 16 maunds per acre being recorded and marketed in some villages. *Toria* suffered somewhat from frost and in places from *tela* (aphis). The season was not very favourable for wheat—the yields were everywhere 10% at least below normal. Rust was worse than usual and appeared as early as the first week in February, which is unusual. The somewhat cold weather of February and March retarded development, and this, followed by a very hot spell in April, tended to reduce the yield and produce a shrivelled grain. Canal water was also on the whole much shorter than usual, so that most of the farm wheats could only be irrigated twice. On the second of March a violent hailstorm did great damage locally and some of the farm tenants and surrounding cultivators suffered severely, whereas other parts of the farm scarcely suffered at all. In some fields almost every head of wheat was knocked off.

2. *Sugar-cane, maize and cotton manurial experiments.*—The annual report for 1911-12 gives the details of this experiment. The plan of the experiment, given in the above report, has been slightly modified in that *senji* comes after cotton and is ploughed in

in plot C_1. The permanent experiment which has been going on as below since 1911-12 is as follows, sugar-cane only being manured :—

C_1	Green manure of Senji. SUGAR CANE. Green manure of Senji.	
	+ Crude Nitre 65 lbs. N.	Calcium Nitrate 65 lbs. N.
C_2	Farm yard manure (15 tons per acre).	
	Crude Nitre 65 lbs. N.	Calcium Nitrate 65 lbs. N.
	COTTON. Farm yard manure.	
C_3	Castor cake (10½ cwt. per acre.) MAIZE. Castor cake.	
	Crude Nitre 65 lbs. N.	Calcium Nitrate 65 lbs. N.

This year's results are shown in statements II, III and IV. The yields in all plots are good owing to interculture.

Sugarcane.—The results are remarkable on account of—(1) the heavy yield of *gur* per acre and (2) for the fact that the addition of nitrates to the green manure has resulted in a slight decrease. When sugarcane was previously in this plot, *i.e.*, in 1910, no *senji* had been grown in the cotton and a heavy dressing of nitrate was tried instead. The highest yield of *gur* per acre previously was 41 maunds for *kahu* cane in 1910-11.

Maize.—A slight increase occurs in plots where in previous year some nitrate of lime was added to castor cake.

Cotton.—The effect of the manure applied two years previously is only slight. The total increase in plots where the sugar-cane had received nitrate is only 22 sers.

3. *Second manurial series with sugar-cane, maize and cotton* in the Kharif series and gram, wheat and *toria* in the Rabi series :—

The object of this experiment was explained in the report for 1911-12.

KHARIF SERIES.

Statement V.—Sugarcane.—Farmyard manure gave the best result. None of the other manures excepting bone meal contained nitrogen, and the results confirm the experience of past years that nitrogenous manures raise the yield of cane.

Statement VI.—Maize.—The yields are very heavy in all plots. Nitrogenous manures, notably calcium cyanamide and calcium nitrate, gave the highest yields. The sowing of the maize in lines and interculture, which have been advocated at the farm for the past four years, are largely responsible for the high yields. This practice is being widely taken up in the district now.

Statement VII.—Cotton.—Yields very even. As last year phosphatic manures appear to have very little effect.

RABI SERIES.

Statement VIII.—Gram.—The yields are not particularly heavy in manured plots. Contrary to the usual case manures containing nitrogen and phosphates have given an increased yield of *bhusa* and grain. Lime however has given the best result as regards grain. The unmanured portions yielded well on acccount of the greater air space due to two plot boundaries being close together.

Statement IX.—Wheat.—Manured plots very similar in yields—none being very good. Remarks made last year as regards straw are true for this year also.

Statement X.—Toria.—Yields heavy, though much below previous years, but it is premature to draw deductions.

4. *Statement XI.—Toria in wheat, cotton, toria rotation in square* 26.—The three plots were treated similarly and the results are of interest as they show the southern half of the plots *viz.*, 4, 5, and 6 to be very uniform and well suited for comparative experiments, and the land is better than in the northern half, which was harvested separately in each case.

5. *Spacing experiments with* 3*F. cotton.*—Owing to the attack of jassids on this cotton the yields were very low and no comparison can be made.

6. *Statement XII.—Wheat varietal experiments.*—An exhaustive test was made this year between types 11, 17 and Pusa 12 sown both after wheat and after cotton. Each acre plot as in the case of *toria* was harvested in two parts, as the southern end of the field is more uniform and better than the northern end. Pusa 12 is an early wheat and the conditions prevailing in the year under report were favourable to an early ripening wheat. As will be seen type 11 gave the highest yield in any one plot, but the average of the 2 acres under each of the 3 wheats is as follows:—

	Mds.	Srs.
Type Punjab 17	16	9
Type Pusa 12	18	4
Type Punjab 11	18	4

As will be seen types 11 and Pusa 12 happen to be exactly equal. The test will be repeated. The yields are all low.

7. *Desi versus Rajah plough.*—The wheat was badly damaged by hail and the figures are therefore valueless.

8. *Statement XIII.—Hydraulic experiments (Block B of Square* 10).—These experiments could not be accurately carried out owing to the delay in completing the new water channel and fitting a module. Certain variations in cultivation however have produced interesting results. It will be seen that generally two irrigations with harrowing produced better results than three irrigations where no harrowing was done. This is important and will of course require confirmation.

9. *Statement XIV.—Calcium and Sodium nitrate with wheat.*—This experiment was made with nitrate of soda supplied by the Chilian Nitrate Company, Calcutta. The manured plots appeared to suffer more from rust than the unmanured plots. The increase in yield is very small and would not pay the cost of the manure. This confirms previous results.

10. *Statement XV.—Calcium nitrate on wheat.*—This experiment has been carried on in the same land now for five years. In only one plot is there no deficit from the use of the manure. Some damage was done here by hail. All results obtained so far conclusively show that this manure cannot be profitably used for wheat in the colony.

11. *Statement XVI.—Variety experiments with sugarcane.—Katha* cane is distinctly better than *kahu* in the year under report and compares favourably with *dhaulu*. This was the case last year also though in the previous two years *kahu* cane gave the highest yields on the whole. A sub-variety of *katha* commonly grown in the district will be tried next season.

12. Owing to damage by hail the following experiments are not discussed: (*a*) Hot weather *versus* rain ploughing for wheat. (*b*) Varietal experiments with wheat types other than those in squares 26 and 27. (3) New wheats handed over by the Economic Botanist, Punjab.

13. *Cotton varieties.—American.*—As stated above, the standard used in the case of American cotton for comparative tests *i.e.* variety 3 F, owing to its having suffered from jassids in July and August, yielded poorly, and thus the results are not comparable. Besides 3F the following American varieties are smooth leaved and suffered from jassids, *viz.* 168 F and 179 F, and were discarded. Variety 280 F also suffered to some extent but is being given a further trial on account of the good quality of the lint. Varieties 126 F and 199 F were discarded as there was no room for them. Type 4 F continued to do well. The average yield per acre of 3 F on the Lyallpur farm was (10 acres in 29 plots) 5 maunds 15 sers and the average yield per acre of 4 F was (2½ acres in 5 plots) 9 maunds 24 sers.

Desi varieties.—Only *sanguineum* varieties were tried on a large scale. "Farm selected" broad leaf has again shown its superiority in yield over ordinary "farm selected" which is a mixture of broad and narrow leaved types. The actual figures are—

	Farm selected broad leaf.		*Farm selected.*	
	Mds.	Srs.	Mds.	Srs.
(1)	6	28	6	3
(2)	9	22	7	34
(3)	9	14	8	31
(4)	8	29	8	19
(5)	6	22	6	37
	40	35	38	4

All the above except (1) were on ¼ acre plots side by side. It is proposed to discard farm selected ' and concentrate on ' farm selected broad leaf.'

This year the Economic Botanist handed over three types of cotton (*indicum* and *neglectum*) known locally as Hansi cotton, which is the common cotton of the district.

14. *Green manuring.*—Gram sown in square 26, where barley had been green manured the previous year (*vide* last year's report), gave a total yield of 45 maunds and 11 sers from an area of 3 acres, or over 15 maunds per acre, showing the land to be now in good condition. Barley will be sown in the coming rabi without further green manuring,

A large area had been green manured last year with sann hemp and with gram in tenants' land, but owing to the damage done by hail the results are not comparable.

15. *Statement XVII.—Miscellaneous experiments.—Sugar beet, Mangold wurzel*—Sugar beet was grown on small areas sown at different periods. When sown about the middle of September the yield is quite good. It is being tested again this year in larger areas against mangold wurzel for fodder purposes.

16. *Statement XVIII.—Senji, Shaftal and Berseem.*—It will be seen that *shaftal* yielded heaviest. This year a kind of rust was very prevalent in it and the second cuttings had to be destroyed. When visiting Peshawar in April, however, it was seen that this rust is very common there in *shaftal* and does not seem to be regarded as a serious danger. *Berseem* has never yielded heavily in Lyallpur though this year two cuttings were obtained in some plots on the student's farm.

17. *Cattle-feeding experiment.*—The object was to test the suitability of mixed cotton cake as concentrated food as compared with the usual grain fed on the farm, *viz.* 1 ser gram and 1 ser maize daily. Four pairs of working cattle were chosen and one animal in each pair got a ration of 2 seers of mixed cotton and rape cake and the other animal got an equal amount of gram and maize or barley, *i.e.*, 1 seer of gram and either 1 seer of maize or of barley. This secures even conditions as regards work etc. The weighments taken shewed that the animals kept in uniform condition throughout. The cost of the mixed cake (cotton and rape) per maund was Rs. 2-14-0 and of the gram Rs. 3-3-0 and maize Rs. 2-8-0. A note on this subject was circulated to the members of the Lyallpur agricultural association this spring and some members are giving cotton cake a trial. The latter in a pure form can be had @ 1-12-0 f. o. r. Lahore.

18. *Poultry.*—The poultry was dispersed as follows :—

One Gujar Khan variety to Sargodha ; one variety of black lolabis to Basal ; Bushire fowls and Bushire turkeys to Hansi. This leaves the farm with one variety of Gujar Khan *desi* fowls and one breed of cross turkeys (Bushire *desi* cross), the rest having been sold off. Besides the above we have at present the breeds destined for Hansi and some local selections. It is proposed to select good layers by the use of egg-laying boxes and thus improve the local breeds. This seems to be the most hopeful line of the development.

19. *Farm income.*—The income during the year was Rs. 10,060-3-0. Besides this, seed to the value of Rs. 380 was supplied free to other sections. The expenditure was Rs. 9,261-8-11.

W. ROBERTS,

Professor of Agriculture.

Statement No. I.

RAINFALL DURING THE YEARS 1912-13 and 1913-14.

Rainfall during 1913-14.		Rainfall during 1912-13.	
Name of month.	Rainfall.	Name of month.	Rainfall.
June	2·15	June	·24
July	4·94	July	1·96
August	5·37	August	2·16
September	0 31	September	1·90
October	...	October	1·17
November	0·54	November	...
December	0·54	December	·18
January	0 01	January	...
February	0·62	February	2·07
March	C·96	March	·44
April	1·56	April	·17
May	0·38	May	·28
Total ...	16·84	Total ...	9·57

Statement No. II.

RESULTS OF SUGARCANE GROWN IN THE 1st MANURIAL AND ROTATION SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Area.		Name of variety.	Treatment.	Weight of green tops.		Weight of canes.		Weight of juice.		Weight of gur.		Weight of gur per acre.		Percentage of green tops to canes.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	Remarks.
		Kanals.	Marlas.			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27/C.	1	3	...	Katha ...	Green manuring with senji.	74	3	192	32	108	11	20	17	54	18	38·27	56·15	18·86	10·59	Ploughings ... 2 Harrowings ... 6 *Sohaga* ... 19 times. Hoeings and weedings. 8 Waterings ... 12 Date of sowing, ... 2nd April 1913. Crushing began on 9th February 1914. Crushing finished on 7th April 1914.
	2	4	...	Do. ...	Ditto	117	26	238	0	119	39	24	28	49	16	49·43	50·0	20·57	10·38	
	3	4	...	Do. ...	Green manuring with senji and calcium nitrate at 530·6 lbs. per acre, containing 65 lbs. of nitrogen.	98	21	243	5	124	15	25	14	50	28	40·52	51·15	20·39	10·42	
	4	3	17	Do. ...	Green manuring with senji and potassium nitrate at 488·36 lbs. per acre, containing 65 lbs. of nitrogen.	106	7	215	16	121	30	23	8½	48	9	49·29	56·52	19·05	10·77	

Statement No. III.

OUTTURN OF MAIZE GROWN IN THE 1st MANURIAL AND ROTATION SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area.	Weight of dry stalks.		Weight of dry cobs.		Weight of grain.		Yield per acre.		Remarks.
				Kanals.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	1	Red local maize.	Residue of castor cake at 10½ cwts. per acre.	4	12	11	15	15	11	4	22	8	Ploughings ... 5 Harrowings ... 21
	2		Ditto ...	4	12	12	16	13	13	25	27	10	*Sohaga* ... 12 times.
	3		Residue of castor cake at 10½ cwts per acre and calcium nitrate at 530·6 lbs. per acre, containing 65 lbs. of nitrogen per acre.	4	10	11	18	1	13	32	27	22	Hoeings and weedings 3 Waterings ... 4 Date of sowing 30th July 1913.
	4		Residue of castor cake at 10½ cwts. per acre and potassium nitrate at 488·36 lbs., containing 65 lbs. of nitrogen per acre.	4	13	1	17	27	14	33	29	26	Date of harvesting 8th November 1913.

Statement No. IV.

RESIDUAL EFFECTS OF MANURE ON FARM-SELECTED COTTON GROWN IN THE 1st MANURIAL AND ROTATION SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Treatment.	Area.	Actual outturn.		Outturn per acre.		Remarks.
			Kanals.	Maunds.	Seers.	Maunds.	Seers.	
$27\frac{C}{2}$	1	Residue of farm yard manure at 15 tons per acre and crude nitre 691·5 lbs., containing 65 lbs. nitrogen per acre.	4	5	33	11	26	Ploughings ... 4 Harrowings ... 14 *Sohaga* ... 11 times.
	2	Residue of farm yard manure at 15 tons per acre and basic nitrate of lime at 533 lbs., containing 65 lbs. nitrogen per acre.	4	6	5	12	11	Waterings ... 5 Hoeings and weedings ... 11 Date of sowing 14th April 1913. Picking commenced on 10th September 1913.
	3	Residue of farm yard manure at 15 tons per acre.	4	5	38	11	37	Picking finished on 12th November 1913.
	4	Ditto	4	5	18	10	37	

Statement No. V.

OUTTURNS OF SUGARCANE GROWN IN THE 2ND MANURIAL SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Weight of green tops.		Weight of canes.		Weight of juice.		Weight of gur.		Yield of gur per acre.		Percentage of green tops to canes.	Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.	Remarks.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.					
27	1	Katha cane.	Unmanured ...	37/1320	3	22	3	23	2	2	0	13	11	23	99·3	57·34	15·85	9·09	Ploughings... 4
	2		Superphosphate at 231 lbs. per acre.	1/5	31	9	51	38	29	16	5	5	35	25	60·1	56·59	17·42	9·86	Harrowings 13
	3		Unmanured ...	37/660	8	28	15	24	8	16	1	24	28	21	55·77	53·84	19·04	10·25	*Sohaga* ... 14 times.
	4		Bone meal at 304 lbs. per acre.	1/5	31	6	60	36	32	1	6	6	30	31	51·15	52·58	19·22	10·10	Hoeings & weedings. 9
	5		Unmanured ...	37/660	8	10	15	20	8	24	1	26	29	26	53·22	55·48	19·33	10·72	Waterings 12
	6		Farm yard manure at 4 tons per acre.	1/5	32	5	60	29	32	37	6	21	32	27	52·90	54·21	19·85	10·76	Crushing begun on 28th January 1914.
	7		Unmanured ...	[illegible]	6	30	12	10	6	1	1	8	21	16	55·10	49·20	19·91	9·79	Crushing finished on 8th February 1914.
	8		Basic slag at 658 lbs. per acre.	1/5	27	3	44	17	23	25	4	25	28	13	60·94	53·18	19·76	10·42	
	9		Unmanured ...	37/660	7	23	11	20	6	0	1	8	21	16	65·86	52·17	20·	10·43	
	10		Lime at 560 lbs. per acre.	1/5	27	32	41	30	21	38	4	15	21	35	66·58	52·56	19·93	10·48	
	11		Unmanured ...	37/1320	5	22	9	22	4	29	0	38	33	35	58·11	49·47	20·10	9·94	

Statement No. VI.

RESULTS OF MAIZE GROWN IN THE 2ND MANURIAL SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Weight of dry stalks.		Weight of fresh cobs.		Weight of dry cobs.		Weight of grain.		Yield per acre.		Remarks.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27 D/K	12	Red local maize.	Unmanured	37/1320	0	17	0	22	0	20	0	16	14	28	Ploughings ... 6
	13		Calcium cyanamide at 397 lbs. per acre	1/5	8	1	11	13	9	38	8	10	41	10	Harrowings ... 24
	14		Unmanured	37/660	1	26	2	18	2	3	1	30	31	8	*Sohaga* 14 times
	15		Calcium nitrate at 548 lbs. per acre ...	1/5	7	3	10	19	8	38	7	18	37	10	Hoeings and weedings 4
	16		Unmanured	37/660	1	18	2	5	1	26	1	15	24	21	Waterings ... 4
	17		Farm yard manure at 4 tons per acre ...	1/5	6	32	9	11	7	25	6	17	32	5	Date of sowing 29th July 1913.
	18		Unmanured	2/55	1	13	1	34	1	19	1	10	34	15	Date of harvesting 7th November 1913.
	19		Ammonium sulphate at 384 lbs. per acre	1/5	5	38	9	27	7	34	6	30	33	30	
	20		Unmanured	37/660	1	12	2	2	1	26	1	13	23	25	
	21		Gypsum at 560 lbs. per acre ...	1/5	7	20	7	18	6	12	5	11	26	15	
	22		Unmanured	37/1320	0	29	0	39	0	27	0	22	20	2	

Statement No. VII.

OUTTURNS OF COTTON GROWN IN THE 2ND MANURIAL SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of variety.	Treatment.	Area in acres.	Actual outturn. Maunds.	Actual outturn. Seers.	Outturn per acre. Maunds.	Outturn per acre. Seers.	Remarks.
$27\frac{D}{K}$	23	Farm selected cotton.	Unmanured	$\frac{37}{1320}$	0	10	9	36	Ploughings 4
	24		Bone meal at 304 lbs. and lime at 560 lbs. per acre.	$\frac{1}{5}$	1	31	8	35	Harrowings ... 12
	25		Unmanured	$\frac{37}{660}$	0	21	9	23	*Sohaga* ... ... 8 times
	26		Lime at 560 lbs and ammonium sulphate at 334 lbs. per acre.	$\frac{1}{5}$	1	37	9	24	Hœings and weedings ... 7
	27		Unmanured	$\frac{37}{660}$	0	16	7	0	Waterings 5
	28		Farm yard manure at 4 tons per acre.	$\frac{1}{5}$	1	26	8	11	Picking commenced on 10th September 1913.
	29		Unmanured	$\frac{37}{660}$	0	17	7	21	Picking finished on 17th November 1913.
	30		Bone meal at 304 lbs. and lime at 560 lbs. and ammonium sulphate at 334 lbs. per acre.	$\frac{1}{5}$	2	5	10	25	
	31		Unmanured	$\frac{37}{660}$	0	18	7	34	
	32		Superphosphate at 231 lbs. per acre and calcium nitrate at 548 lbs. and ammonium sulphate at 334 lbs per acre.	$\frac{1}{5}$	2	2	10	10	
	33		Unmanured	$\frac{3}{66}$	0	15	6	26	

Statement No. VIII.

OUTTURNS OF GRAM IN THE 2ND MANURIAL SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	Actual outturn. *Grain.* Maunds.	Actual outturn. *Grain.* Seers	Actual outturn. *Bhusa.* Maunds.	Actual outturn. *Bhusa.* Seers.	Outturn per acre. *Grain.* Maunds.	Outturn per acre. *Grain.* Seers.	Outturn per acre. *Bhusa.* Maunds.	Outturn per acre. *Bhusa.* Seers.	Remarks.
27	1	Local gram.	Unmanured ...	$\frac{37}{1320}$	0	4	0	8	3	22	7	5	Germination on the whole good, growth fairly uniform. Some patches in plots 3 and 9.
	2		Superphosphate at 231 lbs. per acre.	$\frac{1}{5}$	2	15	6	38	11	35	34	30	
	3		Unmanured ...	$\frac{37}{660}$	0	34	2	13	15	6	41	18	Plots 1 and 2 affected by shade of trees.
	4		Bone meal at 304 lbs. per acre.	$\frac{1}{5}$	3	17	8	36	17	5	44	20	Plot 11 a bit patchy: growth not uniform.
	5		Unmanured ...	$\frac{37}{660}$	0	36	2	11	16	2	40	23	
	6		Farm yard manure at 4 tons per acre.	$\frac{1}{5}$	3	22	8	10	17	30	41	10	Ploughings ... 5 Harrowings ... 22
	7		Unmanured ...	$\frac{37}{660}$	0	39	1	33	17	15	32	22	*Sohaga* ... 7 times. Hoeings and weedings ... 1
	8		Basic slag at 658 lbs. per acre.	$\frac{1}{5}$	3	17	7	15	17	5	36	35	Watering ... 1 Date of sowing 21st October 1913.
	9		Unmanured ...	$\frac{37}{660}$	0	38	2	15	16	37	42	14	Date of harvesting 16th-20th April 1914.
	10		Lime at 560 lbs. per acre	$\frac{1}{5}$	4	16	7	20	22	0	37	20	
	11		Unmanured ...	$\frac{37}{1320}$	0	5	0	20	4	18	17	33	

Statement No. IX.

OUTTURNS OF WHEAT GROWN IN THE 2ND MANURIAL SERIES ON THE LYALLPUR AGRICULTURAL STATION.

No. of square.	No. of plot.	Name of crop.	Treatment.	Area in acres.	Actual outturn.				Outturn per acre.				Remarks.
					Grain.		*Bhusa.*		*Grain.*		*Bhusa.*		
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
37	12	Wheat, type No. 9.	Unmanured	37/1320	0	15	2	13	13	15	82	37	Germination good, growth regular, length of straw 4′-5″ to 5′-2″, lodging 50 per cent.
	13		Calcium cyanamide at 397 lbs. per acre.	1/5	3	38	22	31	19	30	113	35	Germination good, growth luxuriant, rust present, straw 4′-7″ to 4′-9″ lodging 95 per cent.
	14		Unmanured	31/660	1	5	4	36	20	2	87	16	Germination good, growth regular, pale, straw 4′-5″ to 4′-10″, lodging 70 per cent.
	15		Calcium nitrate at 548 lbs. per acre.	1/5	4	1	16	12	20	5	81	20	Germination good, growth luxuriant, slight rust, straw 4′-3″ to 5′-2″, lodging 90 per cent.
	16		Unmanured	37/660	1	9	4	16	21	34	78	19	Germination good, growth regular, pale, rust, length of straw 4′-6″ to 4′-10″, lodging 10 per cent.
	17		Farm yard manure at 4 tons per acre.	1/5	4	7	15	21	20	35	77	25	Germination good, growth regular, rust present, attacked by white-ants, length of straw 4′-6″ to 4′.10″, lodging 55 per cent.
	18		Unmanured	9/55	0	25	4	7	17	7	114	32	Germination good, growth regular and uniform, lodging 30 per cent., length of straw 4′-9″ to 4′-10″.
	19		Ammonium sulphate at 334 lbs. per acre.	1/5	3	23	13	19	17	35	67	15	Germination good, growth regular and uniform, darkest green, lodging 75 per cent., length of straw 4′-2″ to 4′-10″.
	20		Unmanured	37/660	1	1	4	22	18	11	81	6	Germination good, fairly uniform growth, length of straw 4′-5″ to 5′-3″, lodging 5 per cent.
	21		Gypsum at 560 lbs. per acre ...	1/5	3	30	12	6	18	30	60	30	Germination good, growth regular, length of straw 4′-3″ to 4′-9″, lodging 4 per cent.
	22		Unmanured	37/1320	0	15	1	7	13	15	41	36	Germination good, growth fairly uniform, lodging 2 per cent., length of straw 4′-5″ to 4′-10″.

Ploughings	5	Hoeings and weedings	3
Harrowings	13	Waterings	2
Sohaga	8 times		

Date of sowing 12th November 1913.
Date of harvesting 22nd-28th April 191 4.

Statement No X.

RESULTS OF TORIA GROWN IN THE 2ND MANURIAL SERIES ON THE LYALLPUR AGRICULTURAL STATION IN RABI 1913-14.

No. of square.	No. of plot.	Name of crop.	Area in acres.	Treatment.	Weight of straw.		Weight of grain.		Weight of grain per acre.		Remarks.
					Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
27	23	Toria.	37/1320	Unmanured	0	17	0	8	7	5	Pretty early good crop.
	24		1/5	Bone meal at 304 lbs. and lime at 560 lbs. per acre.	3	5	1	30	8	30	Like No. 23 in early ripening, fairly good crop, uniform.
	25		37/660	Unmanured	0	25	0	18	8	5	Rather thin stunted growth but fairly early.
	26		1/5	Lime at 560 lbs. and ammonium sulphate at 334 lbs. per acre.	4	12	2	22	12	30	Later than all, good crop, 25 per cent. lodged.
	27		37/660	Unmanured	0	25	0	16	7	14	Thin and stunted like Nos. 23 and 24 in ripening.
	28		1/5	Farm yard manure at 4 tons per acre ...	3	32	1	28	8	20	Like No. 24 in ripening, fair crop, a bit thin in branching.
	29		37/660	Unmanured	0	34	0	22	9	32	Thin and stunted, very early.
	30		1/5	Bone meal at 304 lbs., lime at 560 lbs., and ammonium sulphate at 334 lbs. per acre.	5	2	2	27	13	15	50 per cent. lodged, later than all above, good crop.
	31		37/660	Unmanured	1	1	0	25	11	5	Fairly good crop, fairly early like No. 28.
	32		1/5	Superphosphate at 231 lbs. calcium nitrate at 548 lbs., and ammonium sulphate at 334 lbs. per acre.	6	36	3	6	15	30	60 per cent. lodged, very late, very good growth.
	33		37/660	Unmanured	1	2	...	20	8	36	Like Nos. 23 and 24, healthy crop.

Statement No. XI.

OUTTURNS OF TORIA GROWN IN AREA A_2, SQUARE 26.

No. of square and area.	No. of plot.	Area.	Weight of Bhusa.		Actual outturn of grain.		Outturn of grain per acre.		Remarks.
		Kanals.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
26/A_2	1	4	9	3	5	34	11	38	Ploughings 5
	2	4	10	2	6	11	12	22	Harrowings 9
	3	4	9	33	5	35	11	31	*Sohaga* ... twice.
	4	4	9	26	6	28	13	16	Waterings 3
	5	4	9	3	6	20	13	0	Sown on 16th September 1913.
	6	4	8	23	6	20	13	0	Harvested on 7th January 1914.

Statement No. XII.

COMPARATIVE TEST OF WHEAT TYPES 11, 17 AND PUSA 12.

No. of square.	No. of plot.	Area.	Name of type.	Actual outturn.				Outturn per acre.				Previous crop.	Remarks.
				Grain.		*Bhusa.*		*Grain.*		*Bhusa.*			
		Kanals.		Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
26	A 3/1 a	4	Pusa 12 ...	8	8	14	1	16	16	28	2	Wheat ...	Germination good, attacked by white ants, rust present, early in ripening, tillering poor, lodging 50 per cent.
	A 3/1 b	4	Ditto ...	9	34	18	27	19	8	37	14	Do. ...	
	A 3/2 a	4	Punjab type 11 ...	7	1	13	4	14	2	26	8	Do. ...	Germination good, rust present, tillering good, attacked by white ants.
	A 3/2 B	4	Ditto ...	7	23	12	23	15	4	25	4	Do. ...	
	A 3/3 a	4	Punjab type 17 ...	6	20	10	31	13	...	21	23	Do. ...	Germination good, rust present, tillering good, attacked by white ants.
	A 3/3 b	4	Ditto ...	8	16	15	31	16	32	31	22	Do. ...	
	A 4/1 a	4	Pusa 12 ...	8	22	19	24	17	4	39	8	Cotton ...	Germination good, growth luxuriant early in ripening, poorly tillering.
	A 4/1 b	4	Ditto ...	9	34	18	2	19	23	36	4	Do. ...	
	A 4/2 a	4	Punjab type 11 ...	10	3	21	12	20	6	42	24	Do. ...	Germination good, growth uniform, tillering good, rust present.
	A 4/2 b	4	Ditto ...	11	22	26	5	23	4	52	10	Do. ...	
	A 4/3 a	4	Punjab type 17 ...	7	8	11	32	14	16	23	34	Do. ...	Germination good, tillering poor on the rest-house side.
	A 4/3 b	4	Ditto ...	10	14	23	...	20	28	46	0	Do. ...	

	Areas A-3.	*Areas A. 4.*
Ploughings	5	5
Harrowings	10	17
Sohaga	7 times.	8 times.
Hoeings and weedings	6	5
Waterings	2	2
Date of sowing	14-11-13	12-11-13.
Date of harvesting	23—29-4-14	23—29-4-14

Statement No. XIII.

OUTTURN OF WHEAT GROWN IN THE HYDRAULIC EXPERIMENTAL SERIES BLOCK B OF SQUARE 10.

No. of square and plot.	No. of sub-plot.	Treatment.	AREA.	ACTUAL OUTTURN.				OUTTURN PER ACRE.			
				Grain.		Bhusa.		Grain.		Bhusa.	
			Kanals.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.
B 1 plot 2	1	2 Kiaris, ordinary cultivation, no harrowing, 3 waterings	2	1	10	3	2	5	0	12	8
Do.	2	2 Kiaris. ordinary cultivation, with deep harrowings and 2 waterings	2	2	23	5	22	10	12	22	10
Do.	3	2 Kiaris, ordinary cultivation, no harrowing, 3 waterings	2	3	4	6	20	12	16	26	0
Do.	4	2 Kiaris, ordinary cultivation, with deep harrowing and 2 heavier waterings ..	2	2	32	8	33	11	8	35	24
B 2 plot 2	1′	2 Kiaris, ordinary cultivation, but no harrowings, 3 waterings	2	1	36	4	18	7	24	17	32
Do.	2′	2 Kiaris, ordinary cultivation, with deep harrowings and 2 waterings ...	2	2	25	4	19	10	22	17	38
Do.	3′	2 Kiaris, ordinary cultivation, no harrowing, 3 waterings	2	2	15	5	28	9	20	22	32
Do.	4′	2 Kiaris, ordinary cultivation, with deep harrowing, 2 heavy waterings ...	2	2	24	5	26	11	18	22	24

Statement No. XIV.

EXPERIMENT WITH CALCIUM NITRATE AND SODIUM NITRATE ON WHEAT.

No. of square and plot.	No. of sub-plot.	Name of crop.	Treatment.	AREA.	ACTUAL OUTTURN.				OUTTURN PER ACRE.				REMARKS.
					Grain.		Bhusa.		Grain.		Bhusa.		
				Kanals.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
10 / B 1 plot 1	1	Wheat type No. 11.	Sodium nitrate at 168 lbs. per acre ...	2	2	3	3	29	8	12	14	36	1. Ploughings ... 4 2. Harrowings ... 10 3. *Sohaga* ... 5 times. 4. Weedings ... 4 5. Waterings ... 3 6. Sown 23rd and 24th November 1914. 7. Harvested, 9th May 1914.
Do.	2		Unmanured	2	2	1	2	36	8	4	11	24	
Do.	3		Calcium nitrate at 168 lbs. per acre ...	2	1	31	4	12	7	4	17	8	
Do.	4		Unmanured	2	1	27	2	38	6	30	11	34	
10 / B 2 plot 1	5		Sodium nitrate at 168 lbs. per acre ...	2	2	31	4	28	11	4	18	32	
Do.	6		Unmanured	2	2	34	3	7	11	16	12	28	
Do.	7		Calcium nitrate at 168 lbs. per acre ...	2	1	35	3	7	7	20	12	28	
Do.	8		Unmanured	2	1	8	2	27	4	34	10	30	
10 / C 1 plot 1	1		Calcium nitrate at 168 lbs. per acre ...	2	2	21	4	14	10	6	17	18	1. Ploughings ... 4 2. Harrowings ... 10 3. *Sohaga* ... 6 times. 4. Chain harrow ... 1 5. Weeding ... 1 6. Waterings ... 3 7. Sown on 23rd and 24th November 1913. 8. Harvested on 9th May 1914. Wheat in manurial plots tillered much better. Vegetative growth good, about a week late in ripening. Sodium nitrate gave better yield both in grain and straw. Rust present. Damaged by hail.
Do.	2		Unmanured	2	2	29	3	39	10	36	15	36	
Do.	3		Sodium nitrate at 168 lbs. per acre ...	2	2	29	5	15	10	36	21	20	
Do.	4		Unmanured	2	3	11	4	30	13	4	19	0	
10 / C 2 plot 1	5		Calcium nitrate at 168 lbs. per acre ...	2	2	30	5	28	11	0	22	32	
Do.	6		Unmanured	2	2	27	5	10	10	28	21	0	
Do.	7		Sodium nitrate at 168 lbs. per acre ...	2	2	31	5	33	11	4	23	12	
Do.	8		Unmanured	2	2	26	4	12	10	24	17	8	

Statement No. XV.

RESULTS OF CALCIUM NITRATE ON WHEAT.

No. of square and killa.	No. of plot.	MANURED.					No. of square and killa.	No. of plot.	UNMANURED.				INCREASE				Increase value of grain at Rs. 3-4-0 per maund and bhusa at 4 annas a maund.	Expenditure at Rs. 10 per maund of Ca (N O $_3$) $_2$.	Deficit.	REMARKS.
		Quantity of Ca (No $_3$)$_2$ per acre.	AVERAGE OUTTURN PER ACRE						AVERAGE OUTTURN PER ACRE.				PER ACRE. OF							
			Grain.		*Bhusa.*				*Grain.*		*Bhusa.*		*Grain.*		*Bhusa.*					
			Mds.	Srs.	Mds.	Srs.			Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
7/8	1	168 lbs	9	0	10	28	7/8	2	4	36	8	16	4	4	11	12	16 2 3	20 7 9	...	1. Ploughings ... 3 2. Harrowings ... 7
	4	168 lbs	9	8	18	38	7/8	3	9	12	13	32	...	...	5	6	1 4 2	20 7 9	19 3 7	3. Weedings ... 5 4. Waterings ... 2
7/9	2	112 lbs	9	36	21	28	7/9	1	6	14	19	28	3	22	2	0	12 0 7	13 10 6	1 9 11	5. Sown 19th November 1913.
	3	112 lbs	13	24	22	28	7/9	4	11	12	21	28	2	12	1	0	7 10 7	13 10 6	5 15 11	6. Harvested on 2nd-4th May 1914. Damaged by hail.

Statement No. XVI.

RESULTS OF VARIETY EXPERIMENTS WITH SUGARCANE.

Name of square and killa.	No. of plot.	AREA.		Variety.	Treatment.	WEIGHT OF GREEN TOPS.		WEIGHT OF CANE.		WEIGHT OF JUICE.		WEIGHT OF GUR.		OUTTURN OF GUR PER ACRE.		Percentage of green tops to cane.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	REMARKS.
		Kanals.	Marlas.			Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.					
12/17	1	1	13	Katha ...	15 tons of farm yard manure.	42	36	72	23	40	36	7	11	35	10	53·11	56·35	17·78	10·02	Ploughing ... 1 Harrowings ... 3 *Sohaga* ... 5 times. Hoeings & weedings 3 Waterings ... 10 Date of sowing 5th April 1914. Crushing began on 6th January 1914. Finished on 17th January 1914.
	2	1	16½	Kahu ...		46	8	81	20	49	38	7	30	33	38	56 68	61·28	15·51	9·50	
	3	1	10	Katha ...		38	20	72	0	38	31	6	26	34	37	53 47	53·85	17·15	9·23	
	4	1	13	Kahu ...		30	32	46	6	28	18	4	11	20	29	66·73	61·65	15·02	9·26	
12/15	1	1	2½	Katha ...		29	5	47	9	25	35	4	18	31	25	61·67	54·79	17·19	9·42	Ploughing ... 1 Harrowings ... 3 *Sohaga* ... 9 times Hoeings & weedings 2 Waterings ... 10 Date of sowing, 7th April 1914. Crushing began on 8th January 1914. Crushing finished on 27th January 1914.
	2	1	12½	Dhaulu ...		37	2	71	31	41	38	6	25	32	24	51·27	58·06	15·79	9·23	
	3	2	2½	Katha ...		47	16	93	0	50	10	8	4	30	19	50 96	54·03	16·11	8·70	
	4	1	4½	Dhaulu ...		34	1	61	17	34	35	5	7	33	39	55·35	56·77	14·58	8·42	

Statement No. XVII.

YIELDS OF SUGAR BEET AND MANGOLD WURZEL.

Name of square with area.	No. of plot.	Name of crop.	Area in marlas.	Date of sowing.	Date of harvesting.	Actual outturn.		Outturn per acre.		Remarks.
						Maunds.	Seers.	Maunds.	Seers.	
27/B.	1	Sugar beet ...	11½	27th July 1913 ...	16th January 1914 to 19th January 1914.	18	8	258	34	
	2	Do. ...	11½	12th September 1913	5th April 1914 to 22nd April 1914.	30	...	426	27	
	3	Do. ...	11½	5th October 1913 ...	23rd April 1914 to 25th April 1914.	24	8	344	7	
	4	Do. ...	11½	17th November 1913	26th April 1914 to 27th April 1914.	11	17	166	8	
36/D.	1	Mangold wurzel	19¾	5th November 1913...	15th May 1914 to 18th May 1914.	39	20	430	36	

Statement No. XVIII.

OUTTURNS OF SENJI (MELILOTUS PARVIFLORA), SHAFTAL (TRIFOLIUM RESUPINATUM) AND BERSEEM (TRIFOLIUM ALEXANDRINUM).

Name of plot with square No.	No. of plot.	Area.		Name of crop.	Weight of green stuff.		Yield per acre.		Remarks.
		Kanals.	Marlas.		Maunds.	Seers.	Maunds.	Seers.	
27/E	1	1	10	Senji	23	9	123	34	
	2	1	10	Shaftal	25 30 15	14 35 27	136 164 83	21 26 24	1st cutting 2nd cutting 3rd cutting } Produce of 2nd cutting was burnt as crop was affected with fungus.
					71	36	384	31	
	3	1	10	Senji	33	36	180	22	
	4	1	10	Shaftal	24 25 12	9 3 6	129 133 64	8 29 32	1st cutting 2nd cutting 3rd cutting } 2nd cutting was burnt.
					61	18	327	29	
	5	1	10	Senji	16	14	87	8	
	6	1	10	Berseem	10	...	53	13	
	7	1	10	Senji	11	1	58	32	
	8	1	10	Berseem	7	4	37	34	

APPENDIX VI.

Report of the officiating Deputy Director of Agriculture on the Gurdaspur Farm.

1. *Introductory.*—I was in charge of the farm from 1st July to 27th October, when Mr. Southern returned from Lyallpur, where he had been officiating as Professor of Agriculture. Mr. Southern was in charge up to 9th April 1914, when he went on leave, and I have been since officiating for him.

2. *Season and its effects upon the crops.*—The total rainfall during the year was 27·6 inches,—*vide* statement No. 1, as compared with 29·05 inches for the last year and with 34·9, the average rainfall of the district.

3. The season was favourable for the kharif but not for the rabi crops. The rain ceased early in August. Then followed an uninterrupted drought during the period the kharif crops are normally making their chief growth and the rabi sowings are done. There was ·05 inches of rain in the end of October, which produced a crust on the barani wheats. The Christmas rains came at the right time, and the crops improved wonderfully with them. But adverse climatic conditions were experienced in the latter part of the rabi season, and outturns were low. The rain in February helped the growth of the late ripening Punjab type 13, but it interfered with the pollination of almost all other wheats, thereby decreasing their outturns considerably—early ripening varieties suffering most. Rust also appeared. To add to it the spring rain was unfortunately followed by violent gales of wind, which caused large areas of promising wheats to lodge badly. This also made the grain shrivelled and light.

4. The area under cultivation is about 85 acres, divided almost equally into chahi and barani areas. It is well controlled, and proper rotation and experiments have been started. The Ashford tube well, which was sunk last year, is working very satisfactorily.

5. **CHAHI AREA**—Following the rotation mentioned in the last year's report, which has been adopted on the farm, there were 10 acres under sugarcane, and 5 acres under senji (*melilotus parviflora*), 13 acres under wheat, 7 acres under maize, and 2 acres under cotton, besides 4 acres of fodder.

6. *Kharif.*—*Sugarcane.* (*Statements* 2 *and* 3).—The land under sugarcane has been cropped practically with no manure, since it was taken over in 1910. The cane this year followed chari (*sorghum*) and the first irrigation after sowing was very late. White ants as usual did their share of the damage. The crop was consequently very thin. Half of the area under thin canes, *i e.*, 4½ acres were under local dhaulu and the other 4½ acres under other varieties. The following experiments were conducted in the fields under dhaulu (statement No. 2) :—

(1) Spacing experiments.—Country method *versus* 1′—9″.

(2) Seed rate experiments—12,000, 16,000, 24,000 sets per acre.

(3) Measures against cane borer—shoot-cutting, no treatment and sowing maize as trap crop

(4) Sets sewn in trenches. }—These two experiments were in field No. 7.
(5) ,, ,, ridges. }

The (1) country method of sowing, *i.e.*, sowing after the plough at a distance of 10 inches to 1 foot and (2) sowing 24,000 sets per acre have given good results. In these plots the crop was not thin. Shoot cutting tends to more tillering and hence the good results. That is in fact why the zemindar is not much perturbed by a mild attack of cane borer. Dhaulu sown in trenches has also done very well.

7. In the other 4½ acres there were 33 varieties. Ten of these, which had done well during the past years, were tried on a large scale. Matna and Kanswar, Behar No. 1 and 2, have been declared by Dr. Barber to be one and the same, so there will be no Behar No. 2 and Kanswar in future. Katha varieties were attacked by smut, while the others were practically safe. Frost did some slight damage, reducing the sucrose contents, but the canes recovered soon afterwards. Kahu was most affected. Barhai behaved badly in analysis and was late. It is sown on a small scale now and may be discarded next year, if it does not improve. No definite results have been obtained so far. Those which have done well in the chemical laboratory and have also given good outturn on the farm are being tried over again. Of the United Provinces varieties dhaura of Azamgarh and reora of Benares appeared to be very promising. Both tiller well. Thick canes were badly damaged by white ants.

8. *Cotton.*—Gurdaspur is not a cotton growing district, nor this is a cotton growing farm. Three cottons were grown for the Economic Botanist to test the effects of environment and climate upon the strength and length of lint. Cambodia cotton was tried under the orders of Sir Louis Dane. It grew very luxuriantly, plants attaining a height of 7 feet ; but it was very late and yielded only 1½ maunds from an acre. The early seed is being tried this year with less irrigation to make it ripen early.

9. *Maize* (statement No. 4).—Spacing experiments with maize were conducted on a large scale this year. 2·6 acres were sown broadcasted and about 3¼ acres were sown in lines 2 feet apart. Even this year the drilled crop has shown no advantage over the other. In reality this experiment so far has never been correctly carried out owing to the unevenness of the field. The lower portions are where the crop is drilled, and the water collecting and standing therein has much to do with the low outturns.

Maize was also sown in trenches, and as the crop grew the trenches were levelled of. The idea was that the root system would be strengthened and the extra few inches in depth would enable the young plant to get a better supply of moisture. The results were not satisfactory. There was a heavy shower of rain after sowing, water stagnated in the trenches and the plants lost vigour.

10. *October sown sugarcane.*—Striped and red mauritius among the thick—treru of Batala, lal hard, reora of Benares, katha and dhaulu among the thin canes, which had so far well resisted frost, were planted last October instead of in March to see if they would ripen before the frost. The thick canes were destroyed by white ants and among the thin canes only katha and dhaulu are in existence and doing well. The others germinated badly and made little progress.

11. *Rabi gram.*—Four seers of gram seed were received from the Imperial Economic Botanist, Pusa, and were sown in field No. 9. It germinated well, but the crop failed through root-rot.

12. *Wheat.*—The well-irrigated crop was very heavy, lodged badly and had nearly all to be cut for fodder.

13. *Ottawa wheat.*—What little seed could be got from last year's crop, was sown this year. It was again very late and yielded shrivelled ugly grain. The original seed which came from Ottawa was a beautiful red.

14. *Dreadnought wheat.*—This seed was obtained from the Agricultural Officer, North-West Frontier Province. It spreads very well in the beginning and looks a fine green fodder wheat. It keeps so for a good long time, and assumes an erect position about the end of February. It is very late and the grain was consequently shrivelled and not well formed.

15. **BARANI AREA.**—This consists of nearly 45 acres, which have been set aside for experiments with wheat cultivation and the investigation of the possibilities of increasing the fertility and moisture capacity of barani soils. The rotation practised is the general barani rotation of wheat—kharif—fallow—fallow—wheat and so on. Some 20 acres come under wheat every year.

16. *Kharif. Mash* (*Phaseolus Mungo*).—It is a common leguminous crop in the district and paying too A considerable area which was under wheat last year (rabi 1912-13) was put under this crop. Spacing experiments, *i. e.*, drilling or sowing in lines 2 feet apart *versus* broadcasting were started. But the crop failed owing to the early cessation of the rains.

17. *Rabi. Wheat.*—The October rain produced a crust. The cloudy weather of February brought about rust on the fields sown, and the rains in February and March disturbed the pollination. It was observed that there were many blind ears among the early ripening varieties like Pusa 4.

18. The following experimental work was done on wheat :—

(1) *Cultivation experiments* (*statement No.* 5)—

(*a*) Hot weather *versus* ordinary cultivation.

(*b*) 9″ deep ploughing *versus* 4½″ deep ploughing.

(*c*) Ordinary *versus* no cultivation till the end of rains.

(2) *Manurial.*—Bonemeal 5 cwt. per acre *versus* no manure.

All the above were duplicated in alternate plots except (1) (c) and the alternate plots were treated alike. Bonemeal and the hot weather cultivation have given no good results.

Deep ploughing even did not give good results this year as follows :—

	Outturn per acre. Mds.	Srs.
Deep ploughing	16	26
Ordinary cultivation	16	37

Outturns in the case of 1 (c) *i.e.*, ordinary *versus* no cultivation show clearly the advantages of cultivation before the rains. The figures are—

	Outturn per acre.	
	Mds.	Srs.
No cultivation till rains	15	12
Ordinary cultivation	19	2

(3) *Comparative tests between* (Statement No. 6)

(*a*) *Local* 13 *and* 14.

(*b*) *Punjab* 13 *and Pusa* 12 (*both on rich and poor soils*).

(*c*) *Pusa* 12, 6 *and* 4 *with Punjab* 14 *as standard.*

Punjab 14 has again given better results this year. Pusa 12 has again shown itself a good barani wheat and promises to be popular. It has big heads, which produce large plump grain and gives a fine uniform sample. This year again it has given higher outturn than Punjab 13. This result is confirmed by the outturns on the seed farms and by the zemindars who grew both types for trial. The grain of Punjab 13 is often shrivelled and its sample is poor and ugly. The above is the result of trials on good soils. On poor soils however Punjab 13 has everywhere fared better than Pusa 12.

19. The great disadvantage in Pusa 12 is that it does not tiller and the seed rate should therefore be increased 25 per cent. It also lacks the barani characteristics of Punjab 13 of being leafy and spreading out flat on the ground and concentrating its energies to develop a good root system, when it first comes up. When grown irrigated, Pusa 12 tillers well.

20. Pusa wheats 4, 6, and 12 were given a trial against each other as barani wheat with local 14 as a check crop. The Pusa wheats are proverbially poor in tillering. Pusa 6 tillers a little better than the other two. Pusa 4 ears early and sheds grain on ripening. It should therefore be cut early when the straw is not quite dry. It was noticed this year also that though Pusa 4 ears early, it is slightly later than Pusa 6 and 12. It has topped other Pusa wheats in outturn and will be given a good trial next year. Its grain is beautiful, white, big and gives an attractive sample. Seed rate experiments with Pusa 12 were started, but the crop was totally spoiled by white ants, and no results could be obtained.

21. *Jat plough.*—The new Jat plough with a long beam, brought out by Messrs. Ransome Sims and Jefferies is not likely to prove successful. Its work is much inferior to the Raja and the draught is heavier. It escapes the objection to the Raja plough that the ploughman is too far away from his bullocks.

22. *Fertilizers.*—(Statement No. 7). Calcium nitrate and calcium cyanamide were received from the Kashmir Darbar last year. The cyanamide arrived too late for a proper trial. They were tried this year in private fields in different villages of the district.

Calcium nitrate was sown after the plough along with the wheat and calcium cyanamide was applied a fortnight before wheat sowing. It was broadcasted and harrowed in. They increased the yield and improved the quality of the grain, but the increase in yield is not large enough to justify the application of the manure. Calcium cyanamide is reported to kill the piazi weeds. The treated plots in the case of both the manures had a darker healthy colour and tillered better, but ripened later than those untreated.

The results are very conflicting due probably to the difference in soils. Kamalabad is sandy, Gurdaspur sandy loam, Bathanwala clay and Nawanpind loam. All the manured crops were heavy and lodged with the spring rains. A drier season would have given clearer results.

23. *Visitors.*—The station is now quite well known in the province and is much frequented by zemindars and officials.

The members of the district agricultural association visited the farm twice during the year. Visitors were shown over the farm and the work was explained. Implements and the tube well were shown working. Dr. Barber, sugar expert to the Government of India, visited the farm twice last cold weather to classify the Punjab canes.

I need not repeat our troubles to house the visitors. Surely something will soon be done for their convenience.

24. *Staff.*—Since M. Charan Singh was appointed Assistant Director, M. Gurdial Singh Agricultural Assistant, has been manager and is showing interest in the work.

M. FATEHUDDIN,

Offg. Dy. Director of Agriculture, Punjab.

Statement No. 1.

RAINFALL DURING THE YEARS 1912-13 AND 1913-1914.

1912-13. Name of month.	1912-13. Rainfall.	1913-14. Name of month.	1913-14. Rainfall.
June	·03	June	4·47
July	9·66	July	8·32
August	11·76	August	3·65
September	·41	September	...
October	...	October...	·05
November	·8	November	...
December	·04	December	1·78
January...	·5	January	·67
February	2·91	February	2·01
March	1·76	March...	1·42
April	...	April	3·40
May	1·18	May	1·83
Total	29·05	Total	27·60

Statement No. 2.

RESULTS OF DIFFERENT TREATMENTS OF DHAULU SUGARCANE.

Serial No.	No. of field.	No. of plot.	Name of variety	Area harvested in square yards.	Weight of canes. Maunds.	Weight of canes. Seers.	Weight of juice. Maunds.	Weight of juice. Seers.	Weight of gur. Maunds.	Weight of gur. Seers.	Weight of shakkar. Maunds.	Weight of shakkar. Seers.	Weight of canes per acre. Maunds.	Weight of canes per acre. Seers.	Weight of juice per acre. Maunds.	Weight of juice per acre. Seers.	Weight of gur per acre. Maunds.	Weight of gur per acre. Seers.	Percentage of juice to cane.	Percentage of gur to juice.	Percentage of gur to cane.	Percentage of shakkar to juice.	Remarks.
1	4	14	Dhaulu, local	1,574	114	35	63	20	10	11	...	...	353	9	195	10	31	24	55·27	16·18	8·94	...	
2	4	13	Maize trap crop	1,574	95	37	50	35	7	26	...	...	297	29	156	18	23	21	53·03	15·03	7·9	...	
3	4	12	No treatment	1,574	90	20	47	20	7	30	...	...	278	11	146	2	23	33	52·43	16·31	8·56	...	
4	4	11	Shoot cutting	1,574	128	9	68	...	6	3	4	33	394	12	209	4	31	21	53·09	15·00	8·48	16·94	
5	4	10	Country method	1,572	120	26	56	20	4	10	5	16	371	19	174	9	29	28	46·82	16·66	7·99	17·41	
6	4	9	24,000 sets per acre.	1,574	135	38	68	34	2	34	7	36	418	2	211	29	33	2	50·64	14·17	7·90	16·15	
7	4	8	16,000 sets per acre.	1,574	113	32	56	10	2	28	6	26	349	37	172	39	28	30	49·42	17·14	8·21	16·41	
8	4	7	12,000 sets per acre.	1,574	117	20	57	...	...	20	8	35	361	25	175	11	28	33	48·51	16·66	7·97	16·43	
9	4	2, 4 & 6	1′—9″ apart ...	4,722	351	39	176	15	19	31	7	10	360	31	180	31	29	30	50·11	16·06	7·67	17·73	
10	4	1, 3 & 5	Country method	4,185	340	10	165	20	26	31	...	19	393	20	191	16	31	21	48·64	15·97	8·008	15·83	
11	7	...	Dhaulu in trenches.	349	51	8	25	20	4	5	...	...	681	16	353	23	57	7	49·804	16·17	8·05	...	
12	7	...	Dhaulu on ridges.	535	33	25	15	20	2	24	...	...	304	8	140	9	27	10	46·01	16·77	7·73	...	

Statement No. 3.

CANE VARIETIES.

Serial No.	No. of field.	No. of plot.	Name of variety.	Area harvested in square yards.	WEIGHT OF CANES.		WEIGHT OF JUICE.		WEIGHT OF GUR.		WEIGHT OF SHAKKAR.		WEIGHT OF CANES PER ACRE.		WEIGHT OF JUICE PER ACRE.		WEIGHT OF GUR PER ACRE.		Percentage of juice to canes.	Percentage of gur to juice.	Percentage of gur to canes.	Percentage of shakkar to juice.	REMARKS.
					Mds.	Seers.	Mds.	Seers.	Mds.	Seers.	Mds.	Seers.	Mds.	Seers.	Mds.	Seers.	Mds.	Seers.					
1	3	1	Dhaulu of Bham ...	1,493	117	...	54	...	9	12	...	...	379	11	175	2	30	6	46·15	17·22	7·83	...	
2	3	2	Katha of Batala ...	1,493	80	12	38	30	7	10	...	...	260	13	125	25	23	20	48·24	18·70	9·02	...	
3	3	3	Traru of Batala ...	1,514	112	31	59	20	9	10	...	21	360	21	190	8	31	10	52·72	16·37	8·66	17·5	
4	3	4	Kansar	1,504	69	29	37	20	7	25	...	...	224	15	120	27	24	22	53·78	20·33	10·93	...	
5	3	5	Kahu	1,499	83	33	46	20	7	30	...	...	270	26	150	6	24	9	55·47	16·12	8·94	...	
6	3	6	Lal hard	1,501	88	37	43	...	8	30	...	...	286	30	138	26	28	9	48·35	20·34	9·83	...	
7	3	7	Reora of Banares ...	1,522	90	18	51	...	...	22	7	27	287	25	162	7	26	6	56·37	18·33	9·09	15·98	
8	3	8	Suretha	1,507	74	10	38	10	7	31	...	...	238	19	122	33	24	39	53·31	20·32	10·83	...	
9	3	9	Barhai	1,513	76	1	37	...	6	27	...	...	243	8	118	14	21	14	48·66	18·04	8·78	...	
10	3	10	Dhaura of Azamgarh ...	1,522	96	37	47	...	...	...	8	7	308	9	149	18	26	...	48·49	...	8·43	17·39	
11	...	...	Behar	205	16	31	7	...	1	10	...	...	396	2	165	11	29	20	41·72	17·85	7·45	...	
12	...	...	Mango	209	11	15	5	...	1	...	...	...	263	16	115	32	23	6	48·95	20·00	8·79	...	
13	...	...	Matki mango ...	214	13	27	7	...	1	13	...	...	309	11	158	12	29	39	51·18	18·93	9·59	...	
14	...	...	Chin	207	16	7	6	20	1	14	...	...	378	8	151	39	31	23	40·18	20·77	8·39	...	
15	...	...	Betakali of Damraon ...	269	12	4	5	5	...	..	...	33	269	14	92	9	14	34	42·36	...	6·81	16·09	
16	...	...	Katara	174	5	38	3	10	...	12½	...	10	165	20	90	16	15	26	54·62	17·85	9·45	16·60	
17	...	...	Matna	439	22	6	12	30	2	20	...	...	244	8	140	23	27	23	57·56	19·60	11·28	...	
18	...	...	Merthi	230	16	38	6	35	1	10	...	...	356	27	144	27	26	12	40·56	18·18	7·87	...	
19	...	...	Mamch of Basali ...	270	14	25	6	...	1	10	...	...	258	16	107	22	22	16	41·52	20·83	8·54	...	
20	...	...	Desi Suretha ...	228	18	38	10	...	2	5	...	...	411	12	217	1	46	5	52·77	21·25	11·21	...	
21	...	...	Patarki mango ...	265	15	7	8	20	...	10	1	10	277	6	155	10	27	16	56·05	16·66	9·88	17·71	
22	...	...	Bodi	217	24	17	11	...	1	32	...	...	544	31	245	14	40	7	45·03	16·36	9·21	...	
23	...	...	Dhaura Kanar ...	262	25	20	13	20	2	10	...	...	471	3	249	...	41	22	52·94	16·66	8·82	...	
24	...	...	Dhaulu Suretha ...	280	23	36	13	20	2	...	...	...	413	5	233	14	34	23	56·47	14·81	8·36	...	
25	...	...	Kanara	218	20	26	9	...	1	20	...	11	458	10	199	32	38	23	48·58	20·00	8·41	18·33	
26	...	...	Do. selected ...	68	3	31	2	10	...	18	...	...	268	28	160	6	32	1	59·6	20·00	11·92	...	

Statement No. 4.

RESULTS OF DIFFERENT METHODS OF SOWING MAIZE.

No. of field.	Variety.	Actual area reaped in square yards.	Total weight of cobs.		Actual outturn.		Outturn per acre.		Nature of experiment.	Remarks.
			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.		
5	Jalandhri ...	8,211½	30	1	23	18	13	23	Drilled 2 feet apart	Ploughing 1 Harrowing 2 Hoeing 2 Watering 2 Date of sowing 17th June 1913. Date of harvesting 22nd September 1913.
5	Do. ...	8211½	39	7	30	23	18	1	Broadcasted ...	...
10 B.	Local ...	4,270	16	...	13	38	15	32	Drilled 2 feet apart	Ploughing 1 Harrowing 4 Hoeing 1 Watering 1 Date of sowing 17th July 1913. Date of harvesting 8th, 12th October 1913.
10 B.	Do. ...	4,270	17	12	12	28	14	16	Broadcasted ...	...
6 D.	Do. ...	1,900	10	38	8	28	22	32	Drilled 2 feet apart	Ploughing 1 Harrowing 2 Hoeing 2 Watering 2 Date of sowing 28th June 1913. Date of harvesting 18th September 1913.
6 D.	Do. ...	360	1	7	1	1	13	31	Sown in furrows ...	...
6 B.	Peshawari ...	4,840	12	31	9	8	9	8	...	Ploughing 4 Harrowing 8 Hoeing 2 Watering 2 Date of sowing 16th August 1913. Date of harvesting 14th December 1913.

Statement No. 5.

RESULT OF DIFFERENT TREATMENTS ON WHEAT.

Field No.	Wheat No.	Actual area reaped in square yards.	Treatment.	Actual outturn.				Outturn per acre.				Remarks.
				Grain.		Straw.		Grain.		Straw.		
				Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
17	13	2,400	Hot weather cultivation ...	10	3	28	22	20	13	57	23	Ploughings 3 Harrowings 15 Cambridge Roller 1 Wheat harrowings 3 Date of sowing 25th and 28th September 1913. Date of harvesting 22nd, 23rd and 28th April 1914.
	14	2,400	Do. ...	10	11	27	20	20	29	55	18	
	13	2,400	Ordinary cultivation ...	10	31	28	21	21	29	57	21	
	14	2,400	Do. ...	9	35	26	22	19	36	53	22	
	13	2,400	Deep ploughing ...	7	30	29	18	15	25	59	16	
	14	2,400	Do. ...	9	13	25	38	18	32	52	13	
	13	2,400	Ordinary ...	7	24	28	13	15	13	57	5	
	14	2,400	Do.	10	15	25	7	20	37	50	31	
	13	2,400	Bone meal 5 cwt. per acre ...	8	18	31	34	17	1	64	9	
	14	2,400	Do. ...	10	18	25	19	21	3	51	15	
	13	2,400	No manure	9	37	29	37	20	1	60	14	
	14	2,400	Do.	10	...	24	6	20	7	48	28	
	Pusa 12	3,200	Permanent wheat plot ...	14	22	28	3	22	...	42	18	Date of sowing 22nd October 1913. Date of harvesting 20th April 1914.

Statement No. 6.

WHEAT YIELDS.

Field.	Type No.	Actual area reaped in square yards.	Actual outturn.				Outturn per acre.				Remarks.
			Grain.		Straw.		Grain.		Straw.		
			Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	Maunds.	Seers.	
					Chahi.						
1	Punjab 17	6,710	30	27	151	24	22	5	106	7	Ploughings 2, harrowings 12, hoeing *nil*, watering 1. Date of sowing 31st October 1913, date of harvesting 18th, 20th and 21st April 1914.
	Pusa 12...	6,910	27	21	200	11	19	11	140	1	
2	Punjab 11	7,369	15	...	103	17	9	34	67	37	Ploughings 2, harrowings 13, hoeing *nil*, watering 1. Date of sowing 1st November 1913, date of harvesting 24th, 27th and 30th April 1914.
	Punjab 18	7,369	21	8	132	2	13	37	88	16	
	Punjab 14	7,369	22	30	116	39	14	38	76	33	
					Barani.						
13	Pusa 6 ...	3,969	8	34	22	1	10	32	26	34	Ploughing 4, harrowings 16, wheat harrowings 3, watering *nil*. Date of sowing 24th and 25th October 1913. Date of harvesting 21st, 23rd and 24th April 1914.
	Pusa 4 ...	4,165	13	25	24	30	15	33	28	30	
	Pusa 12...	4,446	13	6	24	19	14	13	26	26	
	Punjab 14	4,758	16	10	38	5	16	21	38	31	Ploughings 3, harrowings 15, Cambridge Roller 1, wheat harrowing 3. Date of sowing 25th and 28th October 1913. Date of harvesting 22nd, 23rd and 28th April 1914.
17	Punjab 13	22,400	78	29	242	8	17	...	52	13	
	Punjab 14	22,400	86	37	217	28	18	31	47	1	
15	Punjab 13	1,580	6	38	18	26	21	12	57	5	Rich soil. Ploughings 3. Harrowings 13. Wheat harrowing 5. Date of sowing 20th, 22nd October 1914. Date of harvesting 20th, 29th April 1914.
	Pusa 12...	1,580	7	39	18	7	24	17	55	27	
	Punjab 13	8,690	28	17	66	16	15	33	39	11	Ordinary
	Pusa 12...	8,690	21	38	41	18	12	9	23	3	
	Punjab 13	1,580	4	23	10	39	14	1	33	25	Poor soil.
	Pusa 12...	1,580	3	4	6	30	9	19	20	27	

Statement No. 7.

CALCIUM NITRATE AND CYANAMIDE ON WHEAT.

Name of village.	No. of field with plot.	Area in square yards.	Actual outturn.		Outturn per acre.		Manure and rate per acre.	Increase or decrease per acre.		Price at Rs. 3 per maund of increase or decrease.	Price of manure per acre.	Profit or loss per acre.
			Maunds.	Seers.	Maunds.	Seers.		Maunds.	Seers.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Nawanpind.	I—1	1,758	8	12	22	11	Calcium Cyanamide 1·5 cwt.	+ 6	5	+18 6 0	13 8 0	+4 14 0
	2	1,679	5	24	16	6	*Nil.*	...	...	...	...	...
	3	1,476	5	32	19	1	Calcium Nitrate 1·5 cwt.	+ 2	35	+8 10 0	17 4 0	—8 10 0
	II—1	1,754	5	5	14	1	Calcium Cyanamide 1·5 cwt.	+ 4	3	+12 3 6	13 8 0	—1 4 6
	2	1,626	3	14	9	38	*Nil.*	...	...	...	...	...
	III—1	2,405	7	27	15	18	Calcium Cyanamide 1·5 cwt.	— 0	19	—1 6 9	13 8 0	—14 14 9
	2	1,512	4	29	15	37	*Nil.*	...	...	...	...	...
Kamalabad.	1	3,931	13	12	16	15	Calcium Cyanamide 1·5 cwt.	+ 4	31	+14 5 3	13 8 0	+0 13 3
	2	6,194	17	16	13	24	Calcium Nitrate 1·5 cwt.	+ 2	0	+6 0 0	17 4 0	—11 4 0
	3	3,666	8	32	11	24	*Nil.*	...	...	...	...	...
Gurdaspur.	1	5,730	16	13	13	31	Calcium Nitrate 1·5 cwt.	+ 2	20	+7 8 0	17 4 0	—9 12 0
	2	5,747	13	16	11	11	*Nil.*	...	...	...	...	...
Bathanwala.	1	2,708	5	30	9	33	Calcium Cyanamide 3 cwt.	+ 3	3	+9 3 9	27 0 0	—17 12 3
	2	8,611	12	...	6	30	*Nil.*	...	...	...	...	...

N. B.—Price of Calcium Nitrate is taken at Rs. 11–0 per cwt. and that of Calcium Cyanamide at Rs. 9 per cwt.

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